DOCUMENT RESUME

ED 391 683 SE 057 731

TITLE	Web of Life: Exploring Biodiversity. An Educator's Guide.
INSTITUTION	World Wildlife Fund, Washington, DC.
SPONS AGENCY	Eastman Kodak Co., Rochester, N.Y.
PUB DATE	95
NOTE	53p.
AVAILABLE FROM	World Wildlife Fund, Environmental Education Department, 1250 24th Street, N.W., Washington, DC 20037.
PUB TYPE	Guides - Classroom Use - Teaching Guides (For Teacher) (052)
EDRS PRICE	MF01/PC03 Plus Postage.
DESCRIPTORS	Ecology; Elementary Secondary Education; *Environmental Education; Science Activities; Videotape Recordings
IDENTIFIERS	*Biological Diversity

ABSTRACT

"Biodiversity" is the term used to describe the incredible variety of life on Earth, the wealth of habitats that house all the life forms, and the interconnections that tie everything together. This activity guide is designed to help teachers use the "Web of Life" video and to provide information and activities to expand on concepts introduced in the video. It contains a summary of each segment of the video along with key points and discussion questions for each one. The background information is divided into four major sections: "What Is Biodiversity?"; "Why Is Biodiversity Important?"; "Why Are We Losing Biodiversity?"; and "What Are We Doing about the Loss of Biodiversity?" Each background section is followed by two or three related activities. Each activity lists the materials needed and the video segments that complement the activity. The resource section contains a list of reference books, multimedia resources, and activity guides. (JRH)

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WEB OF LIFE

exploring biodiversity

An educator's guide

IDEAS FOR USING
THE "WEB OF LIFE"
VIDEO

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WINDOWS ON THE WILD

Biodiversity is the word used to describe the incredible variety of life on Earth—everything from the tiniest microbes to the tallest trees, from the creatures that spend their entire lives in water to those that are firmly anchored in the soil of the Earth's crust. It's also the word used to describe the wealth of habitats that house all life forms and the interconnections that tie us together. All of Earth's ecosystems and all life forms that have evolved within them—including the fantastic range and expression of human culture—are part of our planet's biodiversity.

As our natural curiosity draws us to find out more about the tremendous variety of life on Earth, we learn that we're losing biodiversity at an ever-accelerating rate. Many scientists believe that this loss of biodiversity is one of the most serious environmental problems our world is facing. That's why World Wildlife Fund and WQED/Pittsburgh are committed to helping educators and their students learn about biodiversity—and that's why we worked together to produce the "Web of Life" education kit.

This kit is designed to help you explore biodiversity issues with your students as you use the "Web of Life" video. We hope that the video and accompanying materials will help motivate your students to find out more about what biodiversity is, why it's important, and how it enriches our lives. We also hope that by highlighting people around the world who are working to protect biodiversity, the kit will inspire your students to get involved.

Judy Braus
World Wildlife Fund

Greg Andorfer
WQED/Pittsburgh

WWF

QED COMMUNICATIONS

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WEB OF LIFE

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This educator's guide is part of *Windows on the Wild*℠—an environmental education program of World Wildlife Fund with support from Eastman Kodak Company. *Windows* is a collaborative effort among WWF, schools, and the nation's zoos, museums, nature centers, botanical gardens, aquariums, and other nonformal education institutions. It uses biodiversity as the organizing theme to help increase environmental literacy and promote responsible citizen action. If you would like to be added to the *Windows on the Wild*℠ mailing list to receive updates on new materials and activities or if you have comments about the primer, video, or educator's guide, please write to World Wildlife Fund, Environmental Education Department, 1250 24th Street, NW, Washington, DC 20037.

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Symbols and Page Numbers

Activity pages marked with this symbol are pages designed to be copied for students.

In this guide, *WOW!* page numbers refer to those pages in *WOW!–A Biodiversity Primer*, a full-color, magazine-style primer included in this kit. Other page numbers refer to pages in this guide. For example, "See pages 15-20 in *WOW!*" refers to pages in the primer. "See page 14" refers to page 14 in this guide.

how to use the "Web of Life" educator's kit

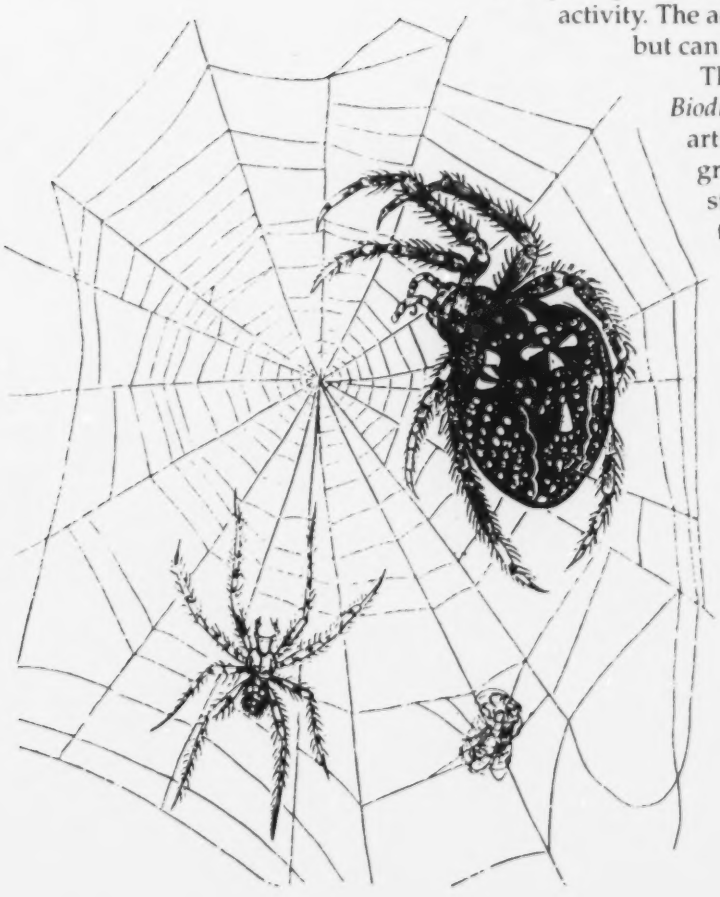
This activity guide is designed to help you use the "Web of Life" video and to provide information and activities that you can use to expand on concepts introduced in the video. The video runs approximately 2 hours. (Part I is 59 minutes and Part II is 54 minutes.)

On pages 3-7, we've included a summary of each segment of the video, as well as key points and discussion questions for each one. You can use this section of the guide to help you decide which segments to show to your group, or to review and discuss specific segments of the program after viewing. The length of each video segment is provided.

The background information is divided into four major sections. Each background section is followed by two or three related activities. The activities do not need to be done in a particular order. They are designed to stand on their own so that you can select those that best meet your teaching goals. However, "Making the Link" (page 14) is an introductory activity that you might want to do before showing the video. Each activity lists the materials needed and the video segments that complement the activity. (Each video segment is followed by a I or II, indicating whether it's from Part I or Part II of the video.) Ideas for extending each activity are provided in "Branching Out" and listed at the end of each activity. The activities are written for 7th-10th grade students, but can be adapted for older and younger audiences.

This kit also includes a copy of *WOW!–A Biodiversity Primer*. *WOW!* features many stories and articles that you can copy and pass out to your group. Where appropriate, we've referenced stories and articles from *WOW!* in specific activities. You can also order classroom sets of the primer by using the enclosed order form.

At the end of the guide you'll find a glossary and a resource section that lists reference books, multimedia resources, and activity guides that can help you and your students continue to explore biodiversity.



summary of video segments

Part I (59 minutes)

Tropical adventure: (18:40) On a trip to the Amazon, Terry Coffey and her son, Dan, explore the tropical rain forest's exhilarating diversity of life. The Coffeys learn how most of the rain forest's life is found high in the trees and how new species are continually being discovered in the canopy, the level of the forest formed by its topmost tree branches.

One scientist, Dr. Terry Erwin, pioneered a method to study species in the hard-to-reach canopy. Erwin shoots an insecticide fog into the canopy of a rain forest tree. (The insecticide doesn't harm other animals, and it quickly breaks down into harmless substances.) Then Erwin identifies the thousands of insects that fall to the forest floor. On average, Erwin finds 1500 to 2000 insect species in each tree. Incredibly, 80 percent of these species are new to science. Erwin's astounding discoveries made biologists rethink their estimates of the number of species on Earth. It's possible that 10 million, or perhaps even 100 million, different kinds of living things inhabit our planet—and so far, we've identified only 1.4 million species.

Besides identifying new species, scientists are uncovering a web of intricate connections among different creatures. In the rain forest, for example, troops of army ants go on patrol to bring food back to their nest. The ants soon attract the attention of antbirds, which feed on insects and spiders flushed by the foraging ants. The swarms of ants also attract butterflies, often called "army ant butterflies." The female butterflies feed on droppings from the antbirds. The droppings supply the butterflies with the nitrogen they need to produce their eggs. Without the army ants, both the antbirds and butterflies would suffer.

There's even an unexpected link between trees and fish. When the river floods the forest each year, fish swim throughout the area that is usually above water. They feed on fruits and seeds dropped by the trees. Many seeds pass undigested through each fish's body and are scattered all over the forest floor. The trees help feed the fish, and the fish help plant the next generation of trees.

Discussion points:

- Would you like to visit a tropical rain forest for your vacation? Why or why not?
- What is your reaction to the fact that no one's really sure how many species live on our planet?
- How did you react to Terry Erwin's method of finding new insect species? What are the pros and cons of his methods?
- Using what you saw in the video, explain the relationships among army ants, antbirds, and butterflies, and between fish and trees in the flooded forest.

(For more information on tropical rain forests, see page 9.)

Capturing kangaroo rats: (4:32) In the Chihuahuan Desert of Arizona, a scientist proved how one species can play a pivotal role in an ecosystem. Dr. Jim Brown set up several study plots in the desert, then trapped and removed kangaroo rats from some of the plots. Brown found that in the plots without kangaroo rats, the vegetation grew dramatically, soon turning patches of the desert into grassland. Tall grass is good habitat for some species, but it isn't good habitat for most desert species. Brown believes the kangaroo rats maintain the desert conditions by kicking up the soil and preventing the grass from growing. He also found that other species were affected by the kangaroo rat's disappearance. Sparrows, for example, couldn't find seeds to eat in the dense grass. Brown's experiments show that keystone species, the ones that are essential to an ecosystem's "working" right, aren't always large, spectacular animals.

Discussion points:

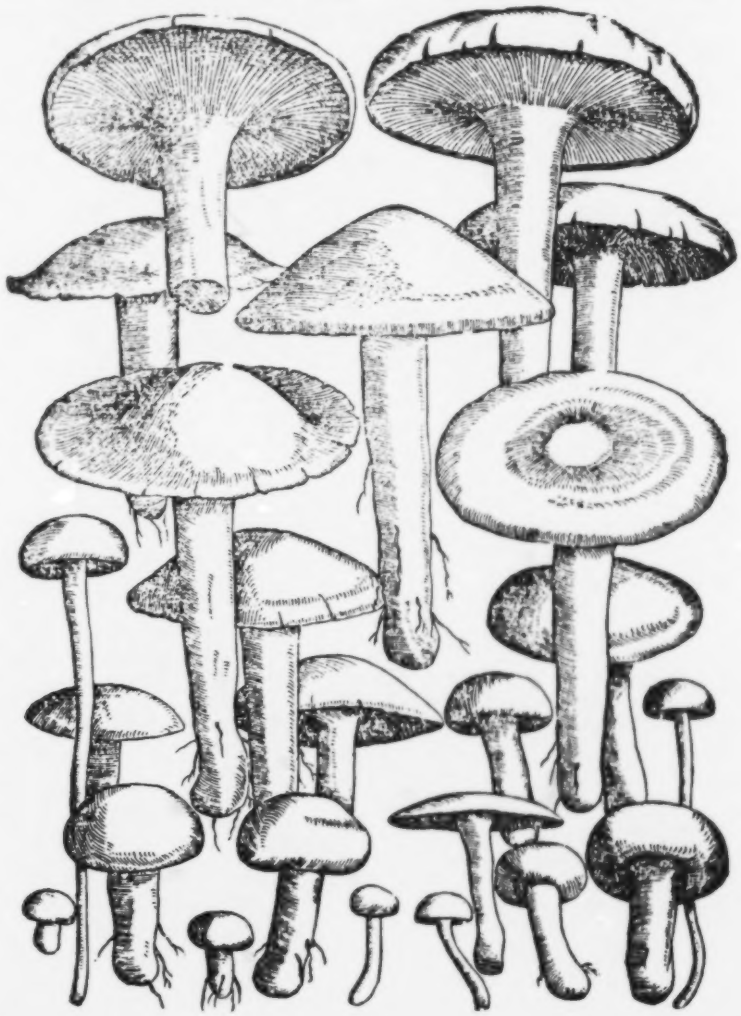
- Why are kangaroo rats so important to this desert ecosystem?
- What species, in addition to sparrows, might be affected by the disappearance of kangaroo rats?

- After watching this segment, did you change your opinion of what species are most important to save? If so, how?

(For more about the importance of keystone species, see "Get the Connection" on page 21.)

Fungi—finding the connections: (5:02) In the forests of Oregon, scientist Mike Amaranthus investigates how fungi form an essential relationship with trees and other plants. Within the forest soil, fungi send out filaments that wind like tiny threads, breaking down dead animals and other materials into nutrients that can be absorbed by plants. Some fungi form a connection with plant roots, allowing the plants to absorb nutrients from the fungal network. In turn, the fungi absorb sugars and other photosynthetic products from those roots.

Amaranthus and other scientists believe most plants couldn't survive without fungi. In fact, without fungi, Earth's first plants probably couldn't have made the transition to a terrestrial lifestyle. Scientists think that fungi may have transported nutrients to the roots of primitive plants and prevented the roots from drying out while the plants established themselves on land.



Discussion points:

- In your own words, describe the connection between trees and fungi.
- Explain how people and fungi are connected. (Fungi help keep plants alive. Plants provide food for people and the livestock that people eat. People depend on plants to maintain the balance of carbon dioxide and oxygen in the atmosphere. Plant roots help prevent erosion, protecting people's yards, homes and farmland.)

Tracking the sounds of diversity: (4:23) To "Sound Tracker" Gordon Hempton, the sounds of life—from the wind rustling through a forest to the gurgling of a river—represent an important form of diversity. He's traveled all over the world to record these sounds. But now Hempton is concerned that the natural sounds of life are being drowned out by our machinery and other technology. We watch Hempton as he follows in the footsteps of early conservationist John Muir, hiking from San Francisco to Yosemite National Park to capture the call of Muir's beloved Merced River.

Discussion points:

- Before watching this segment, did you ever consider sounds to

be a part of the diversity of life? Do you now? Why or why not?
- Name some of the sounds you hear every day. Are most of them natural, or are they created by machines?

Songbirds in the night: (6:33) Bill Evans used to deliver pizzas. Now he tracks migrating songbirds. Like many other bird lovers and scientists, Evans is concerned that songbird populations are declining. So he came up with a new way to track songbirds as they migrate between their summer homes in North America and their winter homes in the tropics. Positioned on a bluff or other high point at night, Evans records the birds calling as they pass overhead. (Scientists think the birds call to each other to stay in contact as they fly.) Then, using a computer at the Cornell Lab of Ornithology, Evans makes a voice-print of each call and matches it with the bird that made it. By counting the number of calls, Evans hopes to determine if songbirds are declining. His idea has revolutionized how scientists track birds and is now used by ornithologists.

Discussion points:
- What do you think of Bill Evans' switch from pizza deliverer to ornithologist?
- How could you find out where birds that live in your community spend the winter?
- Can you think of some ways that you can contribute to slowing the loss of biodiversity?
- Why is it helpful to know if songbird populations are declining?

Why are we losing biodiversity?: (6:46) A montage of threatened animals and plants opens this discussion of the main reasons we're losing biodiversity. Species are becoming extinct faster today than they ever have in Earth's history. The causes are complex and interrelated, but the primary one is loss of habitat—the place where a plant or animal lives and finds the food, water, shelter, and space it needs to survive.

Habitat destruction: The story of the bearclaw poppy shows how some species are especially vulnerable to loss of habitat. Bearclaw poppies grow in only two valleys in Nevada and are found nowhere else in the world. One of those valleys is home to the growing city of Las Vegas. As the city expands, the poppies' survival is threatened. And because efforts to transplant the poppies have been completely unsuccessful, scientists are concerned that they will disappear as the development continues.

Introduced species: Another cause for declining diversity can be found in the Las Vegas Valley—introduced species. When people bring plants and animals into an area where they don't normally live, the "new" species can cause big problems for the native species. That's what happened when early settlers grew salt cedar, a plant from Asia, as a windbreak in Nevada. The salt cedar outcompeted native plants, such as cottonwood and willow trees, for water. Now it's the predominant species throughout the Southwest. Many of the species that relied on the native plants have also disappeared, leaving fewer birds and insects in the non-native salt cedar community.

Over-consumption: Another reason for disappearing biodiversity is that we're overusing the Earth's biological wealth. Commercial fisheries have depleted many of the world's fish stocks; thousands of acres of forests have been cut down for wood products and to make way for agriculture; and wildlife trade has harmed many wildlife populations, including some primates, birds, and fish.

Discussion points:
- What things do you do in your daily life that could contribute to the loss of biodiversity? What do you do that can help slow the loss of biodiversity?
- Do you know of any introduced species in your area?
- What examples of habitat destruction have occurred in your area? What are people doing to help preserve habitat in your area?

Part II (54 minutes)

Ancient music, threatened cultures: (5:26) Two French musicians, Michel Sanchez and Eric Mouquet, are working to preserve the songs of ancient human cultures disappearing around the world. Like other species, these human cultures are endangered by habitat loss, introduced diseases, and other pressures created by our modern world. As part of a project called "Deep Forest," Sanchez and Mouquet have blended together the ancient songs of these peoples with their own contemporary melodies to create a new kind of music. Their first recording features the songs of the Baka, a forest-dwelling people who are also known as Pygmies and live in central Africa. Part of the profits from sales go to help the Baka. Sanchez and Mouquet hope that the recordings will make other people aware of threatened cultures and will encourage them to learn more about the plight of these ancient peoples.

Discussion points:

- Before watching this segment, did you ever think of human cultures as being endangered? What do you think after watching this segment? Explain.
- What are some reasons that human cultures are disappearing? (loss of homeland, lure of modern world, introduced diseases)
- What do you like best about the music of Sanchez and Mouquet?

Techno sapiens*: (7:01) To photographer James Balog, people's increasing reliance on technology separates us more and more from the natural world. And the more we become removed from the world's biodiversity, the more unaware and unconcerned we are of its loss. Balog says that people are changing from "homo sapiens" into "techno sapiens." Through his startling and thought-provoking photographs, Balog strives to make people more aware of this trend, which he feels is disturbing.

Discussion points:

- Do you agree that people's separation from nature contributes to the loss of biodiversity? Why or why not?
- How did you feel looking at Balog's photographs? Which ones struck you most strongly?
- Do you think that you rely too much on technology? Explain your answer.

(For more about "techno sapiens," see the activity on page 33.)

Old-growth forest search: (5:44) Once the forests of the eastern United States were so extensive that it was said a squirrel could travel from the Atlantic coast to the Mississippi River without ever touching the ground. But hundreds of years of logging have left only fragments of virgin forest—most on steep slopes, cliffs, and other rough terrain. Those fragmented areas are where members of the Leverett family look for remaining bits of old-growth forest—stands of ancient trees that have never been logged. So far in their home state of Massachusetts, they've found 40 stands of old-growth forest that can now be protected.

Discussion points:

- Do you know of any old-growth forests that exist in your area?
- Would you go on a hunt for fragments of old-growth forests? Why or why not?
- Should we protect old-growth forests? Why or why not?

Wildflowers, diversity, and drought: (5:31) In Cedar Creek, Minnesota, Dr. David Tilman designed an experiment to study two types of wildflower communities. He set up more than 200 plots in pastureland, and he planted wildflower seeds in each plot to create one of two communities. The first type of community was very diverse, with many different species of flowers; the second community was species poor.

In the midst of the experiment, a severe drought struck the area. Quite by accident, Tilman discov-

* "Techno sapiens" is a trademark of photographer James Balog.

ered that the diverse communities survived the drought better than the communities with just a few species. To Tilman, the message was simple: biodiversity acts as an insurance policy against disaster.

Discussion points:

- What other kinds of disasters do you think a species-rich community could recover from? (droughts, floods, fires, storms)
- Were you surprised that a scientific experiment could be helped by a "disaster"? Why or why not?

Biological reconnaissance: (9:21) One of the biggest problems with preserving biodiversity is that we know very little about many of the species and ecosystems we're trying to save. Around the world, scientists are forming biological reconnaissance teams to quickly learn as much as possible about the species that make up threatened ecosystems. The Kikori wilderness in Papua New Guinea is an area threatened by logging, and Dr. Gary Hartshorn leads the team of scientists studying it. To learn more about the Kikori forests and the animals that live there, Hartshorn works with his Papua New Guinean colleagues to survey varied habitats and learn from local people—especially the traditional medicine people.

Discussion points:

- What kinds of knowledge do you think scientists can learn from local medicine people?
- Do you think the future of the local Papua New Guineans ties to the future of the Kikori wilderness? If so, how?

Wildlands: (5:35) In North America, conservationist Dave Foreman and other citizens are part of the Wildlands Project—an effort to link existing parks and forests into a giant network stretching across the continent. This web-like system would make it possible for wildlife, especially large animals like bears and wolves, to follow ancient migration routes that existed before their habitat was fragmented. To create the Wildlands Project network, people would have to give up large tracts of land and be willing to set aside protected, low-use areas around the network. Eventually, up to 50 percent of North America could become wilderness. Despite the controversy surrounding these ideas, the Wildlands Project is working on a vision map to show people what the network would look like.

Discussion points:

- Would you be willing to give up land that you owned for the Wildlands Project? Why or why not?
- Do you think that Dave Foreman has a valid point when he says he needs to "pay his rent" for all the sunsets he's watched? Do you think that you need to pay "rent" for using and enjoying the Earth's resources?

Local solutions: (7:10) Located in the heart of Nepal, Chitwan National Park is one of the most popular parks in Asia. But this area is also an important agricultural region. Until it was set aside as a park, local farmers relied on Chitwan's land for firewood, building materials, and food for their livestock. But after the land was restricted and a fence was built around the park, the farmers were left without important resources they relied on to survive.

Park officials worked with the local people to come up with a compromise. The officials extended Chitwan's boundaries to the foothills of the Himalayas. In those new areas, they created plantations where local people could grow the trees and grasses they once took from the park. The new plantations have helped reclaim once-barren land and are now creating a greater diversity of plant species within Chitwan. At the same time, the plantations provide a buffer zone to protect the core of Chitwan National Park.

Discussion points:

- What made the local people support this compromise?
- Do you think that local people always support the creation of parks or preserves on their land? Why or why not?

section I: what is biodiversity?

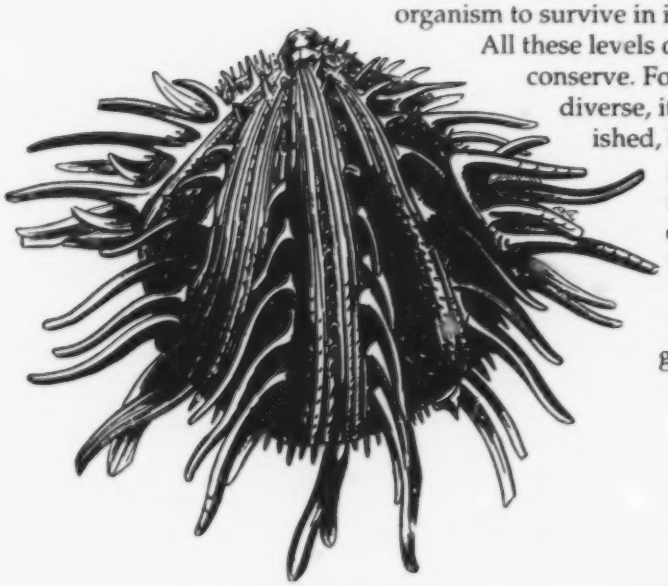
"The diversity of life forms, so numerous that we have yet to identify most of them, is the greatest wonder of this planet."

— Edward O. Wilson, biologist
Harvard University

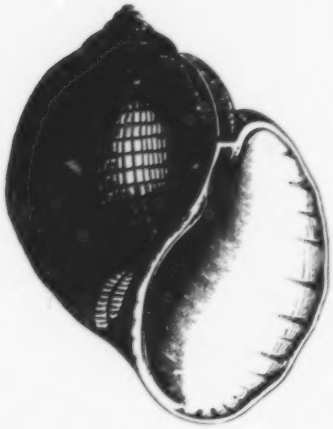
As it spins through space, our Earth carries a precious and unique treasure—life. Scoop just a few teaspoons of soil from your backyard, and there in your hand you hold more living things than exist on all the other planets in our solar system. As far as we know, only Earth supports life. And it's the special mix of an oxygen-rich atmosphere, abundant water, and favorable climate that enables life to flourish.

Earth's variety of life is so great that, amazingly enough, we are far from sure how many different kinds of organisms share the planet. So far, we've identified and named 1.4 million species, including nearly 250,000 species of higher plants, 19,000 different species of fish, 10,000 species of reptiles and amphibians, 4000 species of mammals, and 751,000 species of insects. The rest includes mollusks, worms, spiders, fungi, algae, and microorganisms. But scientists think that millions more species, mostly insects and other invertebrates, are yet to be discovered.

Levels of diversity: This incredible array of living things is what we call biological diversity—or biodiversity, for short. It includes the entire variety of life—everything from tiny organisms in your intestine to great whales that stretch longer than a city block. Scientists look at biodiversity on three different levels. The most familiar is the species level, which focuses on the variety of plants, animals, and microorganisms. Then there's the ecosystem level, a higher level that includes the variety of communities and physical settings where organisms live and evolve, such as estuaries, deserts, wetlands, prairies, and rain forests. And finally there's the lowest level, genetic diversity, which refers to the variety of genes within a species. Genes are the basic units of heredity that give an organism specific characteristics and behaviors, such as a lion's hair color or a cactus' ability to store water. These traits allow an organism to survive in its environment.



All these levels of diversity are connected and important to conserve. For example, if a species becomes less genetically diverse, its chances of long-term survival could be diminished, because it might be less able to adapt to changes in its environment. And if a genetically impoverished species were to become extinct, the variety of life within that extinct species' habitat would be lessened. This could harm other species in the ecosystem. So scientists emphasize that biodiversity is important at all three levels: genetic, species, and ecosystem.



Finding diversity: Talk about biodiversity, and it's inevitable that someone will mention the variety of life in tropical rain forests. It's true that such forests are home to at least half of Earth's known species—but what makes rain forests so unbelievably rich with life?

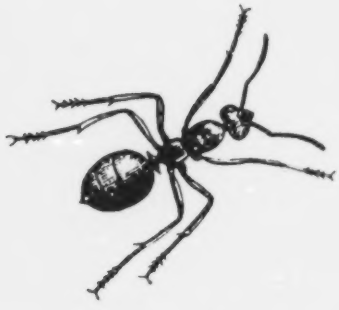
According to one theory, the rain forest's high productivity and favorable climate account for its housing so many species. Abundant rain, sunlight, and year-round warm temperatures make it possible for large numbers of plants to thrive, which in turn creates numerous homes and food sources for other species. These new sources of food, new nesting sites, and so on, foster the development of new species.

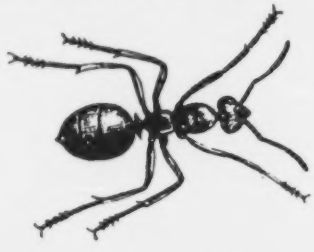
Another theory links diversity with a high level of competition among tropical species. According to this theory, competition promotes diversity by forcing organisms to specialize. For example, among the many fruit-eating birds in the rain forest, one parrot might evolve a beak suited for eating a certain fruit. By becoming the "best" at eating that one kind of fruit, this new species of parrot avoids competing with other species. This, in turn, increases its chances of survival.

Other experts agree that specialization is widespread in the tropics, but they believe the high number of species is a result of an abundant food supply more than competition between species. These experts feel that over time species have adapted to take advantage of the variety of food found in the tropics.

So far, no single theory for rain forest diversity has been accepted by scientists. Most likely, the combination of productivity, competition, and other factors has made tropical rain forests so diverse. But rain forests aren't the only places you can find an exceptional variety of species. Coral reefs are also very diverse. And scientists estimate that the deep ocean floor could be home to 10 million undiscovered species. All around the world, deserts, temperate forests, estuaries, lakes, and other ecosystems are loaded with species, though not as many as are found in tropical rain forests. Experts emphasize that despite all the "press" given to tropical rain forests, it's equally important to protect all types of ecosystems.

Amazing interactions: By itself, the sheer number of different kinds of plants, animals, fungi, and microorganisms on Earth is astounding. But even more astounding are the intricate ways those organisms interact. In the tropics, for example, a certain species of ant and a species of acacia tree depend entirely on each other for survival. The acacia tree has large hollow thorns, which serve as homes for the ants. While it's still a sapling, the acacia is colonized by a queen ant, who begins a colony that may number more than 10,000 by the time the tree matures. The acacia ants patrol their tree, attacking any other insects that climb or land there. These aggressive ants swarm at the scent of cattle and will attack any animals that even brush against the tree. The ants also clip away plants that grow over the acacia, blocking its sunlight. In "exchange" for their protection, the ants find shelter in the tree's thorns, and they get food from special growths that the tree produces on the tips of its leaves. Scientists have discovered that if they remove the ants from young trees, the saplings die. An antless acacia will soon be devoured by insects or other plant-eating animals, or it will be starved of sunlight as other plants grow over it. Unraveling these webs of interactions among species is one of the most extraordinary challenges to face humankind.





BIODIVERSITY THREATENED

Despite all that we do know about our planet, it's quite possible that, so far, we've identified only a small percent of the species that exist on Earth. But the adventure of exploring biodiversity is quickly turning into a race against time. We are now facing the greatest extinction of species since the death of the dinosaurs and other species 65 million years ago. Scientists theorize that the drastic loss of life was initiated by a single event, most likely a massive meteoroid. Today, people are causing animals and plants to become extinct.

Some scientists estimate we're losing three species every hour, 70 species each day. That's a rate thousands of times greater than the natural, or "background" rate of extinction. And, unlike a single event—such as a meteoroid—the pressures on today's wildlife are constant. That pressure means it's difficult for species threatened by extinction to recover. (For a discussion of the reasons we're losing biodiversity, see pages 24-26.)

activity 1: getting started

Overview: Explore, both globally and locally, the diversity of life on Earth.

What You Need: "Web of Life" video, copies of "The Natural Inquirer" on pages 19-22 of *WOW!*, supermarket tabloids, newspapers, art supplies, access to a library or reference materials

Objectives: Define biodiversity. Discuss examples of the diversity of plant and animal species. Describe the biodiversity of your area. Analyze sensationalized language in supermarket tabloids.

Related Video Segment: Tropical adventure (I)

We live on an amazing planet. Life has found its way into nearly every nook and cranny on Earth—and in the process it has produced a complex web of interactions and relationships. To get your students thinking about this web of life and to introduce them to the concept of biodiversity, have them watch the first segment of the "Web of Life" video. Then have them try one or more of the following activities.

The Scope of Life

Have your students work in groups to find and present information on species, interactions, or situations in nature that represent the scope of Earth's biodiversity. Suggest the following categories to help them get started (we've listed a few specific examples in parentheses), but encourage them to come up with categories of their own:

- kingdoms of life (animals, plants, fungi, single-celled organisms)
- wild relationships (sea anemones and clown fish, tick birds and rhinos, fruit bats and fruit)
- good things that come in small packages (kangaroo rats' role in maintaining desert habitats, plankton as an important source of food for marine animals)
- cool colors (parrots, coral-reef fish, orchids)
- fantastic flying machines (bats—the only flying mammal, long-distance migrators such as Arctic terns, monarch butterflies and other migrating animals)
- ecosystems (tundra, forests, wetlands, deserts)
- from tiny to towering (range of sizes among species, from microscopic organisms to whales)
- bizarre behaviors (upside-down courtship dance of male birds of paradise; African Namib dune spiders that roll themselves into a wheel shape then roll at speeds up to 5 feet per second to escape pompilid wasps, their primary predator)

To the extent possible, students' presentations should include information about function. For example, students working on "cool colors" could describe theories about why macaws are brightly colored. And students working on "good things that come in small packages" could discuss the importance of plankton in ocean ecosystems.

After the presentations, have students vote on the best representatives from each category—i.e., the coolest colors, weirdest relationships, most interesting ecosystems, and so on.

Right in Your Own Backyard

Biodiversity is everywhere—not just in rain forests or other exotic habitats. To help open students' eyes to the richness of life in your own area, arrange to have them talk with local naturalists or biologists. They could also take guided "biodiversity tours" at nearby parks.

Once students have a feeling for the kinds of species that are native to your area, have them work in pairs or individually to complete

bio-surveys of some of the species found in their own communities, in their yards, on their school grounds, or in vacant lots near their homes. (You might want to have them work as a class beforehand to develop a class check sheet that they can use in their bio-surveys.)

Have students compile their survey information as a class and use it to develop a "Right in Your Own Backyard" bulletin board or other display.

Tabloid Takeoff

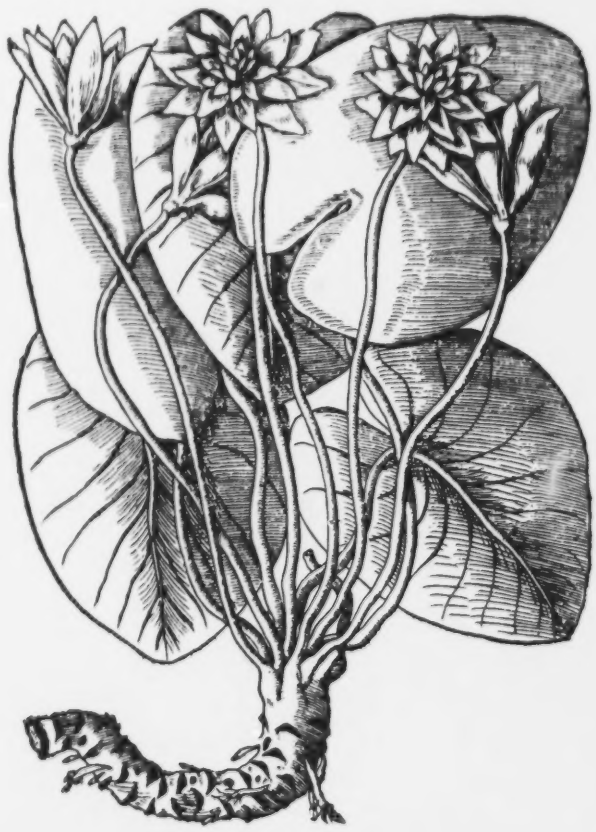
The Earth's biodiversity includes a fantastic array of species, behaviors, and interactions. If you didn't know better, you'd think some were merely the product of a supermarket tabloid writer's imagination. Here's a creative way to put your student's own imaginations to work.

First have your students read "The Natural Inquirer" on pages 19-22 of *WOW!* Afterward, pass out copies of real supermarket tabloids, along with some newspapers. Ask if students can describe the similarities and differences between the two. Then ask the following questions:

- How is the language in supermarket tabloids different from language in other newspapers?
- Why are stories in tabloids sensationalized, and how do writers use language to make them that way?
- Are any articles in regular newspapers sensationalized? How?
- Do you believe the information in tabloids as much as that in other types of publications? Why or why not?

Next have your students compare "The Natural Inquirer" to the supermarket tabloids. Again, have them describe similarities and differences. It's important to explain that the tabloid stories in *WOW!* were written as a "takeoff" on the tabloid writing style. Sensationalized titles, language, and writing style are similar, but the articles in "The Natural Inquirer" contain accurate information about the plants and animals described. Many articles in supermarket tabloids, on the other hand, are often criticized for containing misleading—or just plain wrong—information.

Finally, have your students create a classroom tabloid of biodiversity-related topics. They can base their articles on existing pieces in newspapers, magazines, or journals, or they can pick a topic they'd like to know more about and do some research for their stories. (Remind them that, although they can play with the language to make the stories fun to read, the information they include should be accurate.) Have the students publish their tabloid and distribute it around the school.



activity 2: figuring diversity

Overview: Create a bar graph showing the number of known species that represents different groups of organisms.

What You Need: copies of "Sizing Up Species" on pages 12-13 of *WOW!*, graph paper, colored markers (optional: computer)

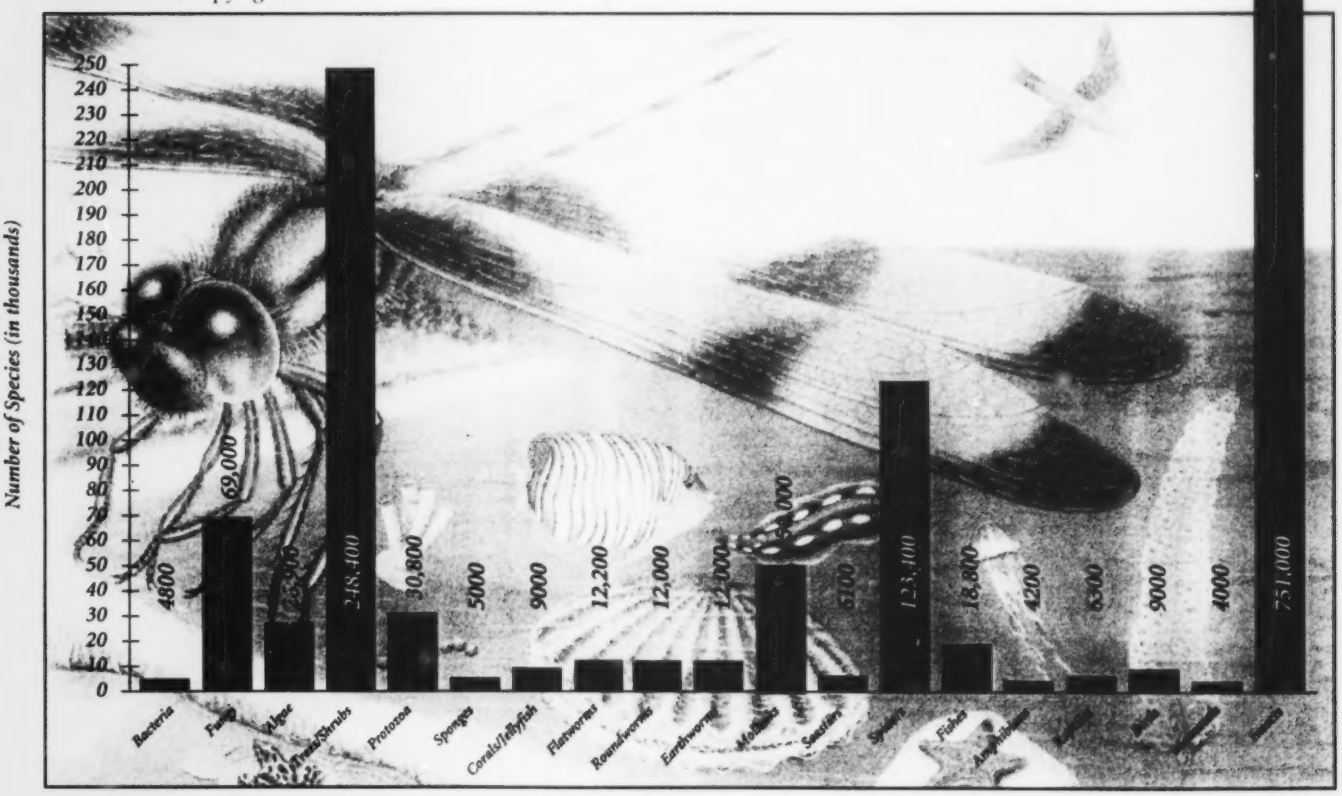
Objectives: Compare the number of species in different groups of organisms. Make a bar graph using real data.

Related Video Segments: Tropical adventure (I); Biological reconnaissance (II)

Activity adapted from *WOW!-An Educator's Guide*, Published by World Wildlife Fund, copyright 1994.

The "Tropical adventure" segment of "Web of Life" includes a description of entomologist Terry Erwin's research in the tropical forests of Latin America. To the amazement of many people, Erwin discovered hundreds of new insect species every time he fumigated a different tree, accounting for up to 80 percent of the species he found in each tree. Erwin's discoveries made biologists rethink their estimates of the numbers of species on Earth.

Before starting, make copies of "Sizing Up Species" for your class. The article presents a visual comparison of the numbers of known species in different groups of organisms. Ask your students to read "Sizing Up Species." Afterward, have students create bar graphs of the information on page 13 of *WOW!* Your students can draw the graphs by hand or on a computer. Explain that the vertical axis should increase in increments of either 5000 or 10,000. If they'll be creating the graphs by hand, provide graph paper and colored markers or pencils. Students will each need about four sheets of graph paper to make room for the bar of 751,000 insect species that have been identified. They might be surprised by the results!



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activity 3: making the link

Overview: Make a list of top environmental problems and describe how each affects biodiversity.

What You Need: writing materials, copies of "Ask Dr. B!" on pages 4-10 in *WOW!*

Objectives: Define biodiversity and describe several ways that environmental problems affect it.

Related Video Segments: Tropical adventure (I); Why are we losing biodiversity? (I)

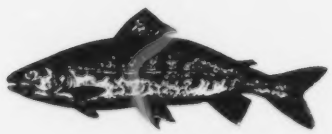
The loss of biodiversity has been identified by many experts as one of the most critical environmental problems facing the world. Yet, according to recent studies, most Americans don't know what biodiversity is or that it is threatened. In a 1993 national opinion survey conducted by Peter D. Hart Research Associates[1], only 1 percent of the people surveyed listed "endangered species" as a serious environmental problem, no one mentioned biodiversity loss as a problem, and only one in five (22 percent) had ever heard of the "loss of biological diversity."

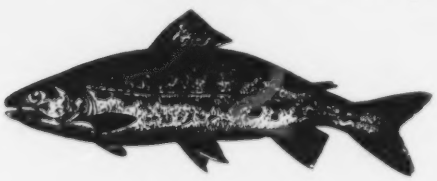
Here's a way to introduce your students to biodiversity and to show them how the loss of biodiversity is connected to other environmental issues. Before starting, make enough copies of "Ask Dr. B!" for your class. Then begin by organizing the students into groups of four or five. Ask the groups to each come up with a list of the most serious environmental problems they can think of. Next, have the groups look over their ideas, then discuss and write down the three issues they think are the most serious. Explain that there are no right or wrong choices—you just want them to discuss their ideas and opinions. Encourage students to include all group members in the discussions.

After students complete their lists, ask each group for its top three issues. Write them on the board and indicate which issue got the most "votes." You'll probably find that your students listed issues such as deforestation, endangered species, air and water pollution, trash, and others that relate either directly or indirectly to biodiversity. Next, explain that they're going to explore an issue that many scientists and other experts feel is one of the most serious environmental issues the world is facing; this issue is affected by all other environmental problems. Then ask your students if they've ever heard of biodiversity. (You might ask if someone wants to try to define it.)

Pass out copies of "Ask Dr. B!" for your students to read. Afterward, discuss the following questions:

- What is biodiversity?
- What are the different types of diversity scientists refer to when they talk about biodiversity?
- Why is biodiversity important?
- What are the major threats to biodiversity?
- Why does Dr. Edward Wilson believe biodiversity should be protected?





[1] From "Highlights from a National Public Opinion Study on Biodiversity" conducted for Defenders of Wildlife, July 20, 1993, by Peter D. Hart Research Associates, Inc.

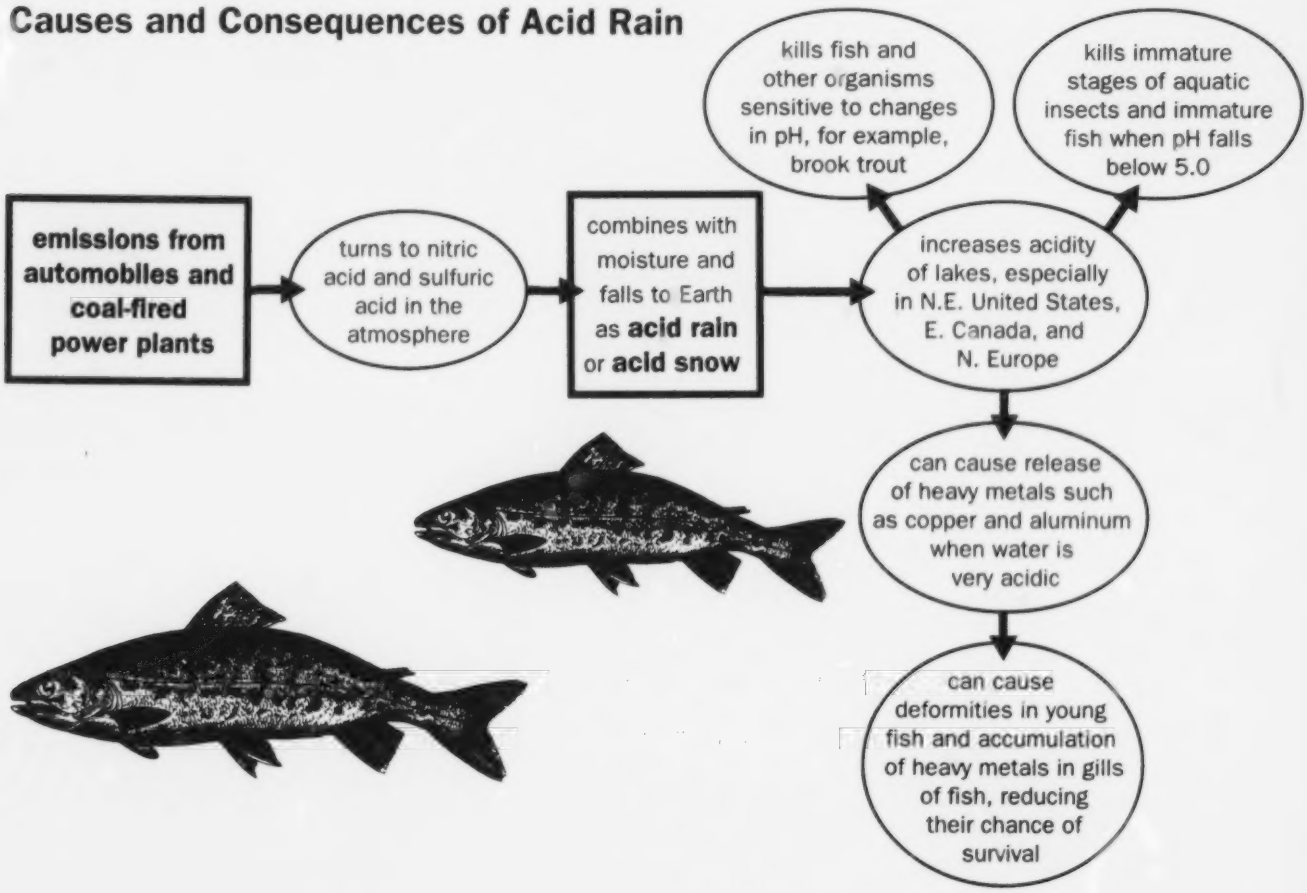
After your discussion, have your students look again at their class list of environmental problems. Did loss of biodiversity make the list?

Next, draw the diagram from this page on the board. Tell your students that many environmental problems affect biodiversity. Then using the diagram below, show how acid rain and acid snow can affect living systems and contribute to biodiversity loss. You can also use the diagram on page 16 to illustrate the relationships between biodiversity and depletion of the ozone layer. (You might want to leave some circles blank and see if the students themselves can predict some of the links.) Afterward, ask your students to discuss the "seriousness" of biodiversity loss and to tell you what else they'd like to learn about biodiversity issues.

Branching Out

- Show the video segments entitled "Tropical adventure" and "Why are we losing biodiversity?" to illustrate some of the things students have learned about biodiversity and its relationship to environmental problems such as habitat loss and over-consumption.
- If your students are already knowledgeable about various environmental issues, have them work in groups to choose a problem from the list and create a diagram to show the connections to biodiversity.
- Ask your students to survey peers and adults to find out if they have heard of biodiversity and can define it. Have students present their findings and

Causes and Consequences of Acid Rain

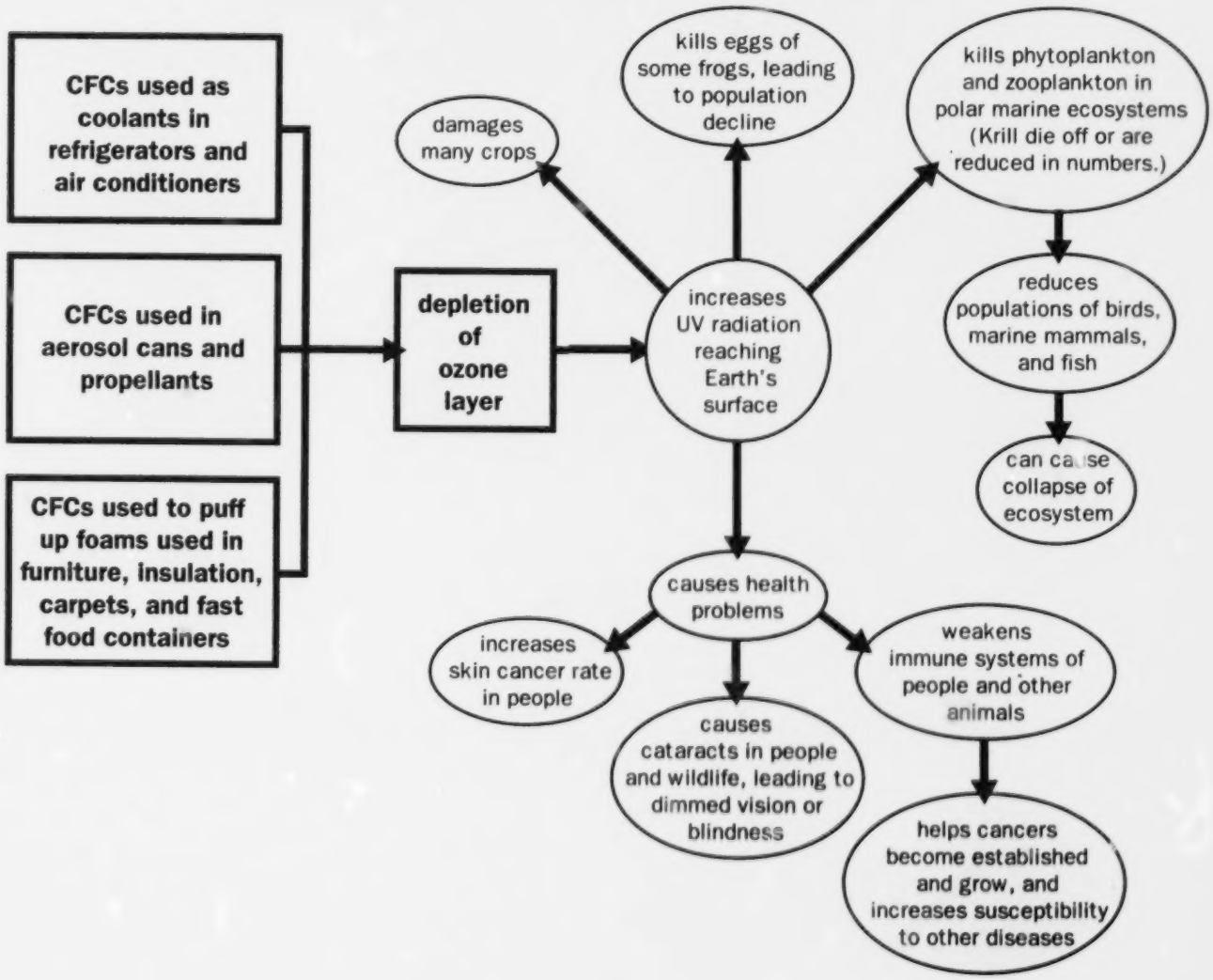

emissions from automobiles and coal-fired power plants
turns to nitric acid and sulfuric acid in the atmosphere
combines with moisture and falls to Earth as acid rain or acid snow
increases acidity of lakes, especially in N.E. United States, E. Canada, and N. Europe
kills fish and other organisms sensitive to changes in pH, for example, brook trout
kills immature stages of aquatic insects and immature fish when pH falls below 5.0
can cause release of heavy metals such as copper and aluminum when water is very acidic
can cause deformities in young fish and accumulation of heavy metals in gills of fish, reducing their chance of survival

discuss the results. Ask if they think it is important for people to understand what biodiversity is. What do they think people should know and understand about it?

- Have your students compare their class list of environmental issues to that of Dr. Norman Myers, an environmental scientist. Myers' list includes explanations and solutions. It's called "What Ails the Globe?" and is found on pages 34-41 in the March/April 1994 issue of *International Wildlife*, published by the National Wildlife Federation.

Activity adapted from *Windows on the Wild*—an environmental education program published by World Wildlife Fund, copyright 1995.

Causes and Consequences of Ozone Layer Depletion


CFCs used as coolants in refrigerators and air conditioners
CFCs used in aerosol cans and propellants
CFCs used to puff up foams used in furniture, insulation, carpets, and fast food containers
depletion of ozone layer
increases UV radiation reaching Earth's surface
damages many crops
kills eggs of some frogs, leading to population decline
kills phytoplankton and zooplankton in polar marine ecosystems (Krill die off or are reduced in numbers.)
reduces populations of birds, marine mammals, and fish
can cause collapse of ecosystem
causes health problems
increases skin cancer rate in people
causes cataracts in people and wildlife, leading to dimmed vision or blindness
weakens immune systems of people and other animals
helps cancers become established and grow, and increases susceptibility to other diseases

section II: why is biodiversity important?

"Ecosystems work when all the small elements are in place, and they don't work as well when pieces are pulled out. Ultimately, the survival and well-being of people, as well as fish and other wild creatures, are dependent on maintaining the health of complete natural systems."

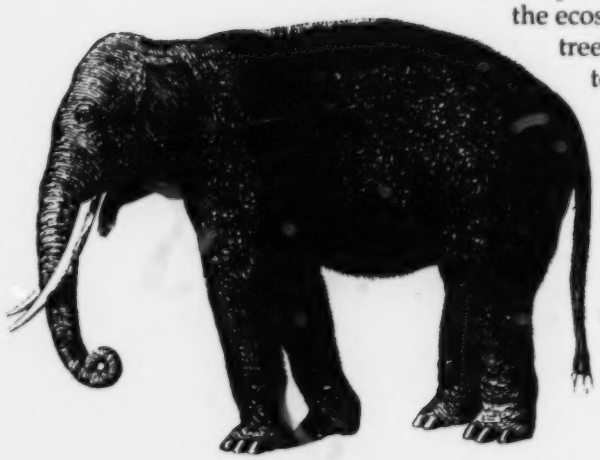
— Sylvia Earle, marine biologist and former chief scientist of NOAA

Variety may be the spice of life—but how much diversity do we really need? No one knows for sure. Even experts can't predict the point at which the loss of biodiversity will have serious consequences for us and the planet. But we do know that biodiversity produces a lot of benefits. Here are some of the reasons people feel we should be concerned about the biodiversity that's already slipping away.

The value of variety: Preserving biodiversity guarantees a rich mix of genes, species, and ecosystems that, in the future, could provide us with the means to adapt to our ever-changing environment. Wild plants, animals, and microorganisms have already provided us with a plethora of products. One species of wild tomato from the Andes ended up being worth 8 million dollars to commercial makers of tomato paste. Over 3000 antibiotics, including penicillin and tetracycline, were originally derived from microorganisms. And the seemingly insignificant Pacific yew tree produces compounds effective in the battle against ovarian and breast cancers. Such discoveries show that even organisms that, with our limited knowledge, might seem worthless today have the potential to provide us with new foods, medicines, or other products tomorrow. (For more about potential products from wild species, see "Raiders of the Lost Potato" on pages 40-49 of *WOW!*)

Life-support systems: Earth's organisms and ecosystems are our planet's life-support systems. They maintain our atmosphere, keep the soil fertile, cleanse our water, and generally keep things running smoothly. But the loss of biodiversity threatens our natural life-support systems. As the variety of species in an ecosystem decreases, scientists think that ecosystem's ability to provide life-support services can change too.

The "key" to ecosystem integrity: Keystone species—organisms that many other organisms depend on, either directly or indirectly— are critical to maintaining the integrity of an ecosystem. If a keystone species' population changes dramatically, it's likely that some fundamental changes will soon take place in its community. For example, when elephant populations in Africa declined because of overhunting, the ecosystem changed dramatically. Without elephants to feed on trees, the trees began to flourish and the grasslands gave way to dry forests. As a result, many grassland species were replaced by woodland species and the entire ecosystem changed. And if elephant populations increase significantly, changes will occur in favor of grasslands.



American oysters are mollusks that filter their food from the surrounding water. According to scientists, the Chesapeake Bay once had so many oysters that they filtered all the Bay's water every three days. But because of overharvesting and disease, the oyster population has fallen by 99 percent since 1870. Now it takes a year for the remaining oysters to filter the Bay's water—one reason the Chesapeake is increasingly muddy and oxygen poor. And

the worsened water quality is making it harder for submerged plants, fish, and other Bay species to survive.

A question of ethics: Another reason to preserve biodiversity deals with how people feel about life in general. To many people, all species are valuable simply because they exist. Each species, no matter how puny or pesky, has developed a combination of traits that help it survive in its environment. According to this viewpoint, each living thing is an irreplaceable product of millions of years of evolution and should be cherished, respected, and protected for its inherent value.

Quality of life: As the pace of life increases, people are turning more and more to nature for an escape from everyday pressures. To these millions of people who rely on hiking, hunting, fishing, or following other outdoor pursuits to recharge their mental and spiritual batteries, diminishing biodiversity threatens the very quality of their lives. For them, a retreat to a world without wildlife offers little satisfaction. According to this viewpoint, although our need to connect with nature is something we don't understand, it may be more important than we think to our mental well-being and success as a species.

For the future: Some people believe that it's important to save biodiversity not only for our needs, but also for others. Those people believe future generations are entitled to a legacy of biodiversity. Proponents of this view feel that our descendants have just as much right as we do to live in a world filled with variety and maintained by natural ecosystems.

LIFE IN A CLUMP OF SOIL

Want to see biodiversity in action? Pull up a plant from your backyard, and use a magnifying glass for a close-up look. There, in the earth clinging around the roots, an entire community performs many of the "services" that keep us alive. Springtails, nematodes, earthworms, and other invertebrates feed on dead plants and animals, breaking down those materials and recycling their nutrients. Invisible to your eye, a battalion of bacteria convert nitrogen gas, an element essential to life, into a form that can be used by plants. A network of fungi, visible as thin white threads, aids the decomposition process. The fungi form links with the plants' roots, exchanging nutrients produced by decomposition for sugars produced by plants during photosynthesis. The plants' roots take up the nitrogen and other nutrients, transferring them to stems and leaves where they become part of the plants' living tissue. As the plant photosynthesizes, it takes in carbon dioxide and releases oxygen, helping to maintain the delicate balance of gases that make up our atmosphere.

activity 4: biodiversity—the spice of life

Overview: Explore the reasons for protecting biodiversity.

What You Need: six large pieces of flip chart paper, thick markers, tape, "Reasons to Protect Biodiversity" on page 20

Objectives: Describe six reasons for protecting biodiversity. Explore personal values and beliefs regarding biodiversity.

Related Video Segments: Capturing kangaroo rats (I); Fungi—finding the connections (I); and Wildflowers, diversity, and drought (II)

"Web of Life" highlights several reasons why protecting biodiversity is important. This activity explores those and other reasons while helping students discover how their own beliefs and values influence their thinking about biodiversity.

Before starting the activity, write each of the six statements on page 20 on a separate piece of flip chart paper. Use thick markers and write large enough so students can read the statements from all areas of the room. Hang each piece of paper in a different location in your room, taping it high enough for everyone to see. Next, read each one out loud, or call on different students to read each one.

Ask students to carefully consider all the statements before standing in front of the one they feel either is the most important reason for protecting the diversity of life or describes best how they feel. Explain that there is no single right answer and that it's fine if they are standing alone or with a group.

After everyone has made a selection, have the students in each group discuss among themselves why they went to "their" statement. Remind them that each person will have personal reasons for making the choice and that they should explore some of those reasons. Give them four or five minutes to discuss their thoughts before asking one person from each group to summarize the discussion. After each group's representative has talked, ask if anyone's views changed after hearing from other groups. Discuss the underlying beliefs and values that drew people to particular statements.

Branching Out

- Several segments of the video may help students better understand some reasons for protecting biodiversity. Show the segments "Wildflowers, diversity, and drought" and "Capturing kangaroo rats." What reasons for protecting biodiversity do these segments highlight?
- The video shows many examples of human diversity. Ask your students if any of the reasons they discussed earlier for protecting biodiversity also apply to protecting human diversity. Why or why not? You may want to mention that many indigenous cultures around the world (Yanomami in Brazil, Dani in Western New Guinea, and Ainu in Japan, for example) are threatened by some of the same factors that affect biodiversity in general, including pollution, over-consumption, and habitat loss.

Activity adapted from *Windows on the Wild*—an environmental education program published by World Wildlife Fund, copyright 1995.

REASONS TO PROTECT BIODIVERSITY

- It is important to conserve the diversity of life for medical and economic reasons. Plants and animals could provide us with additional foods, medicines, and other products that will save lives and benefit society.

- It is important to protect the diversity of life because it helps maintain important ecological functions such as oxygen production, pollination, and flood control, which in turn help support all life on Earth.

- Our lives would not be as rich if we lost species such as bears, whales, hawks, frogs, elephants, tigers and the habitats where they live. The rich diversity of life also provides important recreational activities such as hiking, fishing, and camping.

- It is important to preserve the diversity of life because no generation has the right to destroy the environment and resources on which future generations depend.

- It is morally important to preserve biodiversity because all species have a right to exist.

- It is important to protect the diversity of life because it provides inspiration and provokes curiosity and imagination. Art, music, and poetry are often inspired by the diversity of life. And many of our scientific discoveries, such as flight, can be attributed in part to the possibilities that nature provides.

activity 5: get the connection

Overview: Take part in an opinion poll and discuss the ecological importance of all species.

What You Need: copies of the opinion poll on page 23, pencils, chalkboard or easel paper

Objectives: Compare people's views about protecting different species. Discuss views about which species should be protected and why.

Related Video Segments: Fungi—finding the connections (I); Why are we losing biodiversity? (I)

"There are no roots in these forests. There are roots in the sense that they anchor the tree to the soil, but it's not the roots that are the absorbing surfaces in forests. It's the fungi."
—Mike Amaranthus, scientist

We've seen quite a bit of publicity about the plight of large, charismatic animals like mountain gorillas, tigers, and humpback whales. But most people aren't aware of the perils facing many small and "unglamorous" species such as tiger beetles and the desert poppies featured in "Web of Life." By participating in a biodiversity opinion poll, your students will explore the "value" they place on different species. Afterward, they can examine the important roles some of the smaller, lesser-known species play in their habitats—such as the fungi described by Mike Amaranthus in "Web of Life."

Part A: Everything Counts

Before starting, make enough copies of the "What Do You Think?" opinion poll on page 23 for everyone in your group. Then give a copy to each person. Explain to your students that they should read the questions carefully and then write down their answers on a separate piece of paper. Be sure to point out that there are no right or wrong answers. Also go over any unfamiliar creatures before the group begins.

When all students have finished the opinion poll, summarize their responses on a chalkboard or piece of easel paper. Then discuss the poll using the information under "What's Important?" in Part B.

Part B: What's Important?

After tallying the students' responses, discuss how people's attitudes toward other species can affect their feelings about preserving biodiversity. For example, some people are more willing to protect birds and mammals than plants, insects, amphibians, and reptiles. Also, most people would rather focus on saving large, beautiful animals than smaller, less beautiful ones. For example, most people would probably favor a panda protection program over an insect protection program because it's easy to think that large animals are more important than small ones, and that mammals and birds are more important than insects, amphibians, and reptiles. Another common feeling is that animals are more important than plants and microorganisms.

Explain that despite many people's opinions, all species of plants, animals, and microorganisms play important roles in natural communities. Protecting the biodiversity of a community means protecting all the creatures that live there. For example, fungi may not seem like very important organisms. But as "Web of Life" shows, many scientists think trees can't survive without the fungi that live in their roots and help them absorb nutrients. (You might want to show the "Fungi—finding the connections" segment to

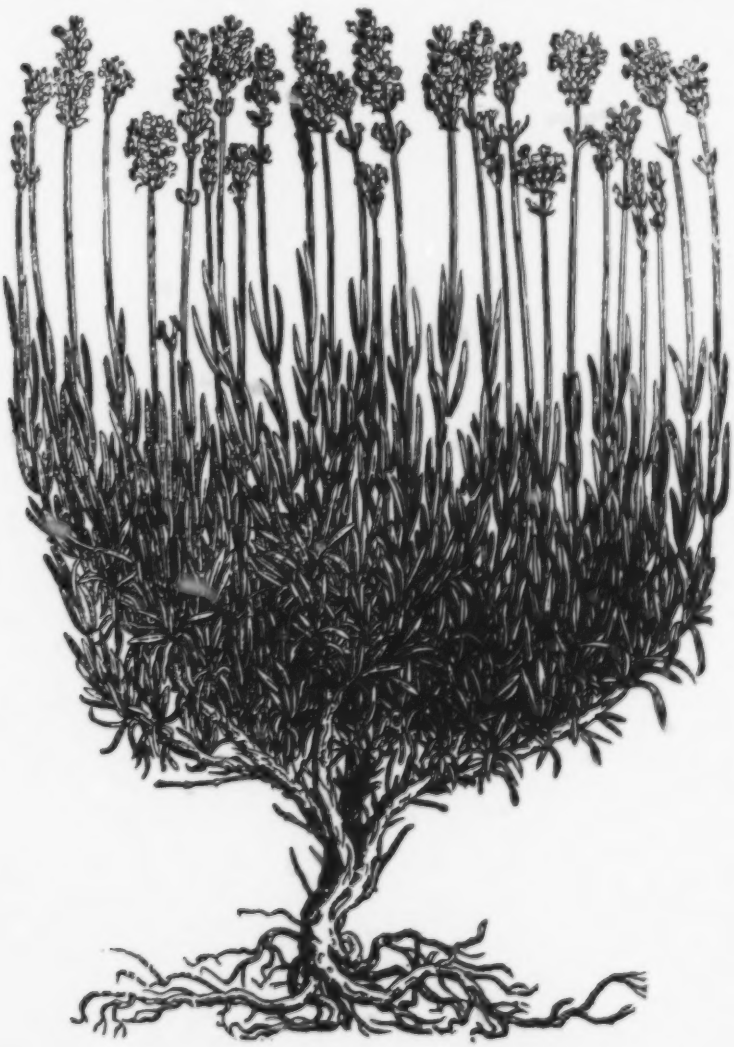
illustrate this point.) And without trees, many animals wouldn't be able to survive.

In your discussion, emphasize how all living things depend on plants for food, homes, and other "services." But despite their importance, plants rarely get as much attention as animals—even though plants are severely threatened in many areas. (You may want to show the "Why are we losing biodiversity?" segment illustrating the plight of desert poppies.) Some scientists predict that a fourth of all tropical plants are likely to be wiped out by the year 2020. Scientists predict this loss could have a drastic impact on tropical animals and could even affect the balance of gases in our atmosphere.

Next, point out that scientists often have to set priorities based on time constraints, money limitations, and other factors—despite the fact that all species are important. Information that might help to set these priorities includes how seriously a species or habitat is endangered, whether or not a species is a keystone species, how much it costs to protect a species, or specific habitat, what political considerations affect them, and so on.

To emphasize the fact that all species have roles in the communities where they're found, divide your students into several teams and give the teams the following challenge: They must show how one small or not-so-glamorous animal, plant, or other organism is important to a natural community (see the suggestions below). Have teams develop a presentation to share their findings with the rest of the group. Encourage them to make their presentations not only informative, but also creative. For example, they could make murals, put on skits, or write raps.

Possible species: krill, dung beetle, earthworm, honey bee, oak tree, phytoplankton, penicillin mold, mangrove, American oyster, termite, coyote, hyena, vulture



Branching Out

- Students can ask one or two adults to fill out the "What Do You Think?" opinion poll. Then they can compare the adults' answers to the group's and discuss ways to educate people about the importance of all species.

Activity adapted with permission of the National Wildlife Federation from the *Endangered Species: Wild and Rare* issue of *NatureScope*, copyright 1987, 1989.

what do you think?

1 Your town council is planning to build a new recreation center in your neighborhood. But the proposed site is the home of an endangered butterfly, and building the rec center might wipe it out. Do you think it's OK to build the center on that site? Explain your answer. What else would you need to know to make the decision?

2 Would you feel different if an endangered bird were living on the site instead of an insect? Why or why not?

3 Which of the following do you think is most important to save?
a. animals that are very beautiful
b. top predators such as grizzlies, wolves, and killer whales
c. all types of animals
d. animals that provide people with food or clothing
e. animals that are keystone species

4 You have just been put in charge of a team that will be working to save the 10 endangered species listed below. But you have enough money and materials to work with only one species at a time. Number the plants and animals in the order you would try to save them, with #1 being the most important species to save. (If you feel you need more information about a species before making a final decision, write what you would like to know beside the species' name.)

___ cheetah
___ salt marsh harvest mouse
___ fuzzy sandozy, an endangered fungus in the northwest United States
___ gray bat
___ mission blue butterfly
___ desert pupfish
___ lady slipper orchid
___ pygmy rattlesnake
___ giant panda
___ whooping crane

5 Is it equally important to save both animals and plants? Why or why not?

section III: why are we losing biodiversity?

"It wouldn't be the first time in history that a species eradicated another one, but it will certainly be the first time in history that a single species managed to eradicate a fair percentage of the rest of life on Earth, and it will certainly be the first time it's being done by [members of] a species perfectly capable of knowing what they are doing...."

— Thomas Lovejoy, biologist
Smithsonian Institution

According to some experts, more than a million species may become extinct before the end of this century. One way to understand why this massive loss of life might occur is to consider the HIPPO Dilemma. Contrary to the title, the dilemma isn't about endangered hippopotamuses. Instead, HIPPO is an acronym for the five main reasons we're losing biodiversity—**H**abitat loss, **I**ntroduced species, **P**ollution, **P**opulation growth, and **O**ver-consumption. These causes are complex and interrelated, but they all have one thing in common—people. Many experts believe that population growth and over-consumption are the forces contributing most to habitat loss and pollution.

Habitat loss: The number one reason for declining diversity is habitat loss—the destruction of the places where animals and plants live and get the nutrients, water, and living space they need to survive. When people cut down a forest, fill in a wetland, trawl the seabed, or plow a prairie, they change the habitat. This change kills or forces out animals, microorganisms, and plants that lived there, and disrupts complex interactions among species.

Human activities can disturb important processes that keep an ecosystem "working" right. In the Pacific Northwest, for example, people constructed dams across rivers to produce electricity and to direct water for agriculture. Those same rivers form the ancient migration routes for salmon swimming upstream to breed and lay their eggs. The dams have disrupted the process of migration, and salmon numbers have dropped to dangerously low levels, causing economic hardship for people who depend on salmon.

VULNERABLE SPECIES

Some species have characteristics that make them extremely susceptible to becoming extinct. Some, like the native plants and animals that live on the islands of Hawaii, have a very limited range. Many vulnerable species are slow to reach maturity, have long gestation periods, and produce few young. Some species migrate and have habitat needs in multiple areas, or have very specific food or nesting requirements. These factors make vulnerable species especially susceptible to habitat destruction and other people-caused problems.

Introduced species: In the 1930s, farmers in the Southeastern United States needed a ground cover to prevent erosion. They planted kudzu, a climbing vine that was originally from Asia and that had been introduced to the United States a few decades earlier. (Besides its use in erosion control, kudzu is used for fodder and as an Asian medicine.) But, kudzu did its job all too well. Spreading across the countryside, the rapidly growing vine soon became impossible to control. Kudzu outcompeted native plants for sunlight and nutrients. Today kudzu dominates much of the region and is considered a major pest by foresters, farmers, and property owners.

The story of kudzu shows how people can introduce new species to an area—either intentionally or accidentally—and can cause big problems for native species. Introduced species, also called alien species or exotics, often have no natural predators or diseases in a new area, and their populations can easily grow out of control. And native species often have no defenses against introduced species—or the diseases they carry.

Pollution: Pollution's effects on wildlife can be obvious, such as an oil spill coating a seabird's feathers or plastic trash tangled around a sea turtle's neck. But some effects of pollution can be harder to detect. Insecticides can cause reproductive failure in fish, birds, and mammals. The acids in acid rain are invisible, but plants and animals in lakes and forests in many parts of the world are dying because of it. The carbon dioxide spewing into our atmosphere from cars and factories is also invisible—but it may be changing our world's climate and causing habitat changes that wildlife may not be able to survive.

Scientists know that carbon dioxide and other "greenhouse gases" perform an important function in Earth's upper atmosphere by trapping heat that radiates up from the surface of the planet. This layer of gas helps maintain temperatures that make life on Earth possible. But scientists know that concentrations of those gases are increasing, mostly because of human activities, such as using fossil fuels to produce electricity and heat homes, or burning forests to make way for agricultural land.

Scientists don't know for sure what effects growing levels of greenhouse gases will have. Nearly all experts believe that because these gases trap heat, an increased concentration will change our climate on a global scale. In some areas, temperatures could change relatively quickly—much too quickly for some species to adapt. Areas might become too hot or too cold, too wet or too dry, for them to survive. This change could be disastrous for endangered species. Other species, such as tropical mosquitoes, might find the changes favorable and might thrive in the new conditions and spread into formerly unsuitable areas.

Population growth: In 1995, the number of people on Earth reached 5.7 billion—more than twice as many as in 1950. And every day, we add about 250,000 more people to the planet. (At this rate, we're adding the population of Mexico to the world each year.) Although experts expect the world's population to stabilize sometime after 2100, that "stable" population could be between 8 billion and 11 billion people, or more. More people will need more food, clothing, fuel, and other necessities. But supporting such large numbers of people will put enormous pressure on the Earth's resources, and many experts predict an increase in the number of people living in poverty. In most areas, the world's ecosystems are already in trouble. Stretching them any further could cripple the vital services they provide us, such as water purification, flood control, and soil fertility.

Over-consumption: An exploding human population will certainly put growing demands on the planet—but many scientists and other experts think that our population is already at a critical level and that we're already consuming too much. They point out that our lifestyle, especially in the United States and other industrialized countries, isn't sustainable. The experts mean that we're consuming fossil fuels, forests, fish, soil, water, and other resources faster than natural processes can replace them.

WILDLIFE TRADE

Many species have been pushed to the edge of extinction by the trade in wildlife and wildlife products. Although many endangered animals are protected by law, illegal harvesting remains a big problem for rhinos, tigers, hyacinth macaws, sea turtles, giant clams, and many other species. Worldwide, the trade in wildlife and in products made from them is worth ten billion dollars annually. The costs to wildlife are extreme—for example, more than 90 percent of the birds, reptiles, and tropical fish captured for sale as pets die before they ever make it to pet stores.

activity 6: the HIPPO dilemma

Overview: Take part in a group reading activity to find out what's happening to biodiversity.

What You Need: copies of "The HIPPO Dilemma" on pages 23-29 in *WOW!*

Objective: Read and discuss an article focusing on the major threats to biodiversity.

Related Video Segments: Why are we losing biodiversity? (I)

The HIPPO Dilemma is not about hippopotamuses. Instead, HIPPO stands for the five major problems threatening the Earth's biodiversity: **H**abitat loss, **I**ntroduced species, **P**ollution, **P**opulation growth, and **O**ver-consumption. By turning the HIPPO Dilemma into a "jigsaw" reading lesson, your students can learn about what's happening to biodiversity while working on their cooperative learning and language skills.

First divide the class into five groups and assign each group a letter: H, I, P, P, or O. Explain that in their groups they should all read and discuss the section of "The HIPPO Dilemma" article that begins with their letter (H—Habitat loss, I—Introduced species, P—Pollution, P—Population growth, and O—Over-consumption). You might want to give the groups guidelines for their discussion. For example, they could describe the problem, explain what's causing it, and list some of the possible solutions to it. Explain that each group member should understand the problem his or her group is looking at.

Afterward, have the students form new groups of five with one member coming from each of the previous groups. That is, they should be in groups with one former H, I, P, P, and O. Have students teach each other about the aspect of the HIPPO Dilemma they learned during the first part of the activity. Explain that each person is responsible for making sure everyone else in the group understands the information that person's letter stands for. When the students have finished, discuss the HIPPO Dilemma as a group, testing the students' knowledge by asking individuals questions about sections of the article they didn't actually read themselves in the first part of the activity. (You might want to have the original teams regroup and work together to come up with the questions.)

Then, show the video segment "Why are we losing biodiversity?" Discuss the aspects of the HIPPO Dilemma that were covered in the stories of the threatened desert poppies; of the introduced salt cedar in Nevada; and of the overharvested marine resources, forests, and wildlife.

Branching Out

- What aspects of the HIPPO Dilemma are having direct and indirect impacts on your community? See if your students can think of ways your area is affected by the HIPPO Dilemma.
- Have students research regional and global examples of the HIPPO Dilemma. They should compare and contrast situations such as the similarities and differences between the introduction of zebra mussels to the Great Lakes and the introduction of brown snakes to Guam.

Activity adapted from *WOW!–An Educator's Guide*, published by World Wildlife Fund, copyright 1994.

activity 7: super store survey

Overview: Conduct a consumer survey and discuss the findings.

What You Need: copies of the survey on pages 30-32, access to a shopping center, copies of "Malling It Over" on pages 45-50 in *WOW!*

Objective: Discuss the relationship between buying habits and biodiversity loss.

Most people don't realize how much we rely on biodiversity—for food, medicine, clothing, and many other everyday products. And many people aren't aware of the fact that consumer choices affect biodiversity—both positively and negatively. After completing this survey, your students will better understand how they rely on biodiversity, what impact they have on biodiversity, and what they can do to lessen this impact.

Before starting the activity, make copies of the survey on pages 30-32 and of "Malling It Over" on pages 45-50 in *WOW!* Then begin by having your students read "Malling It Over" to get a better sense of how consumer choices affect biodiversity. Afterward, explain that they will complete their survey in local shopping areas to find out how much we rely on biodiversity and how our consumer decisions affect it.

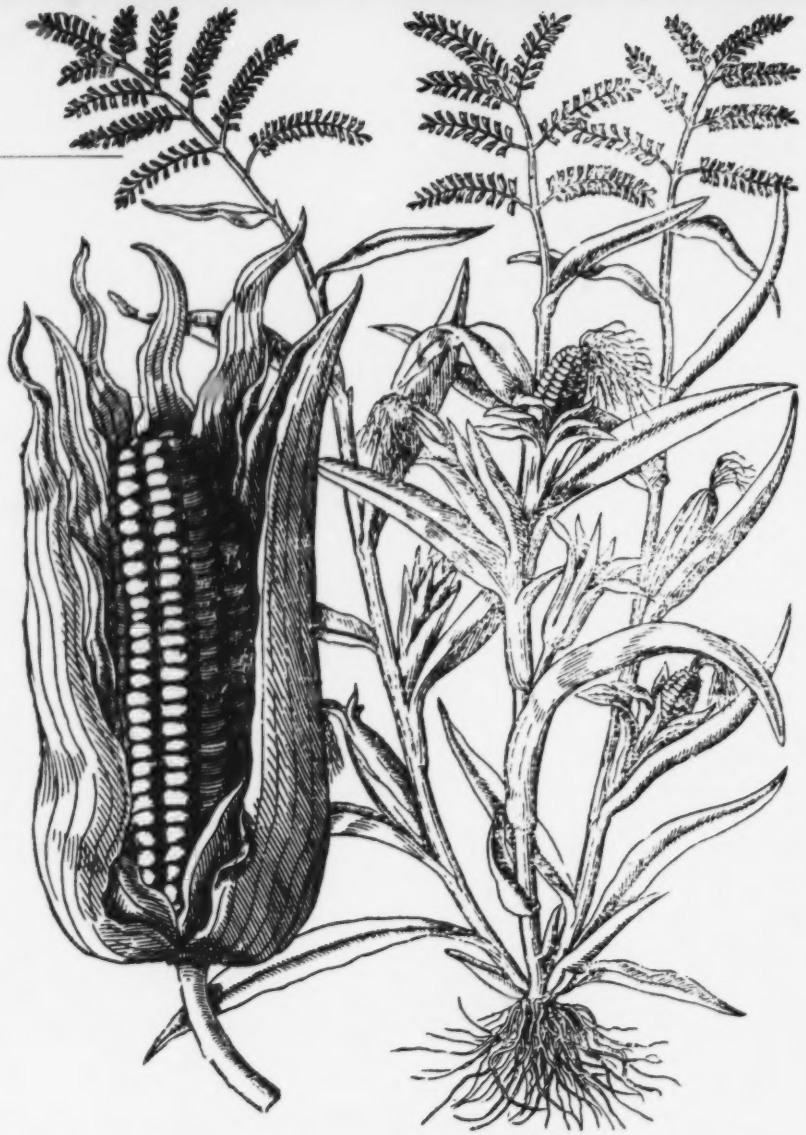
Now pass out copies of the survey. Tell the students that they should try to find everything on the list by visiting a drugstore, fast-food restaurant, department store, magazine stand, and grocery store. A mall or shopping center should provide easy access to all of those types of stores. (You may want the students to work in pairs or small groups.) Go over the survey items with them and see if they have any questions.

Also review any guidelines you would like your students to follow as they interact and observe people in public places. Here are some possibilities:

- Before you ask somebody a survey question, explain that you are doing a consumer survey for school. Then ask if the person has a minute to answer a question.
- Thank people who have helped you.
- Ask questions politely. Don't expect all people to know the answer to your question. It's OK if they don't. Be sure to thank them for their time even if they don't know the answers.
- At the store, inform an employee that you will be looking at product ingredients for a school survey so store merchants will know why you are there.

After your students have completed their survey sheets, use the following questions to discuss their results:

- Were you surprised by the degree to which you rely on plants and animals in the products that you use? Give examples of plants and animals that you rely on. Do people use any plant or animal products that you think should not be used? If so, give examples and explain.
- How knowledgeable were pet store owners about the source of their exotic fish and bird species? How knowledgeable were furniture dealers? Do you think sellers know enough about where their products come from? (You might want to point out to your students that getting information on the origin of pets can be difficult. Some animals are born and raised in the store. Others are obtained through suppliers, so pet store owners don't always know the precise origin of the animals. In some cases, suppliers obtain animals



through illegal shipments. With regard to marine tropical fish, most are taken from the wild and are imported.)

- In what ways can our consumer choices affect biodiversity? List all positive and negative effects you can think of.
- What reasons did the people you surveyed give for their visits to stores? Did any shoppers indicate that they were shopping just to see what they could find? How might such an attitude affect biodiversity?
- How do you feel about buying habits in your region or in the nation as a whole? What connections do you see between consumer choices and the lives of plants and animals?
- Name several ways people rely on biodiversity.
- Can we help protect biodiversity by changing our buying habits? Why or why not? For example, are there different approaches we could use for buying pets? Choosing a brand of paper towel? Selecting a pair of shoes? Do you think people buy too much? Are you willing to make any changes in your buying habits?

You might also want to have your students discuss the range of opinions people have about buying habits, the economy, and the environment. For example, some people feel we've gone too far in protecting the environment at the expense of the economy, while others feel that Americans buy too many products that have too many environmental and social costs. To explore these issues, you could hold a panel discussion with individuals representing a variety of points of view or have students conduct interviews with community members to find out how others feel about these issues.

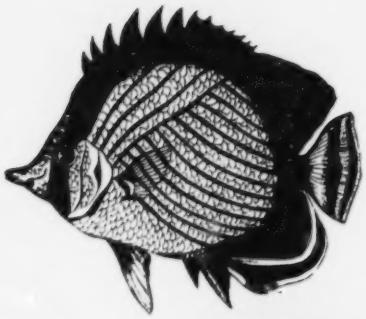
Branching Out

- Ask one or more students to name five things he or she has purchased recently. List the products on the board and have the class think about how each product affects biodiversity. (Think about the production, transportation, use, and disposal of each product.) Then divide the class into small groups and have each group discuss the connections between biodiversity loss and the products we buy.
- Have students work in groups to make a list of shopping tips that might help protect biodiversity.
- Research pet trade issues (especially tropical birds and tropical fish) and find out more about the connection between biodiversity loss and the pet trade.

Activity adapted from *WOW!-An Educator's Guide*, published by World Wildlife Fund, copyright 1994.

WEB OF LIFE

consumer survey



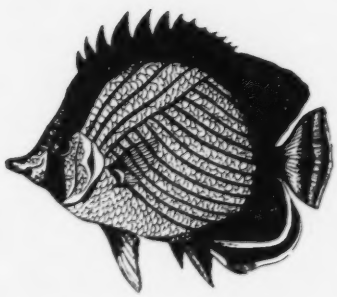
1. Find three products that claim to be made from recycled materials. If possible, list what percentage is made from recycled materials.

Product:	Percentage:	Doesn't list percentage:

2. Find a pet store that sells exotic birds or fish. List three of the species below. Ask the manager or sales person if the animals were imported or bred in captivity.

Store: _____

Species:	Origin:



3. Many cosmetics use ingredients that come from plants and animals. For example, the shimmer of some nail polish is often made from ground-up fish scales (called pearl essence or guanine). A red pigment called carmine is created from the dried bodies of female coccus cacti beetles. And cocoa and aloe are used in many body-care products. Find three examples of cosmetic or body-care product ingredients that come from animals and plants.

Ingredient:	Product:

Look for pearl essence or guanine in nail polish or shimmery eye shadows. Then find a similar cosmetic that doesn't use pearl essence.

Cosmetic containing pearl essence

Brand name:	Type of makeup:

Similar cosmetic without pearl essence

Brand name:	Type of makeup:

consumer survey/page 2

4. Find a piece of furniture, lumber, or other product made from a tropical hardwood such as mahogany, teak, or rosewood. Ask the manager or sales person if he or she knows how the wood was harvested. Does the store have any environmental restrictions on the types of wood or wood products sold, or on how the wood was harvested? Also ask if customers ever request wood products made from trees that were sustainably harvested, and if so, how often.

Product: _____ Type of wood: _____

Manager or sales person's comments:

Have customers requested wood products that are harvested in an environmentally friendly process?

5. Find a belt, purse, pair of shoes, or other product that looks like reptile skin. Look at the tag, or ask a sales person if the product is made from real reptile skin.

Product: _____ Is it real reptile skin? _____

If not, what is it made of?

6. The production of both plastic bags and paper bags uses natural resources including wood, water, and petroleum. Watch 10 shoppers at a cash register, and count how many bring their own bags or request no bag at all.

Number of people requesting no bags: _____

Number of people using bags they brought: _____

Number of people using store bags: _____

consumer survey/page 3

7. Ask a clothing sales person if his or her store has ever carried a line of clothes made with only natural dyes. If so, what was the line of clothes? If not, would the store be likely to carry such a line if customers requested it? Also ask them if they have ever sold clothing made with FoxFibre™, organically grown cotton that comes off the plant in natural colors of white, brown, and green so it doesn't require chemical dyes or bleach.

Ever carried line of naturally dyed clothes: _____

Clothing brand: _____

Likelihood of carrying a line of naturally dyed clothes: _____

Ever carried clothing made with FoxFibre™: _____

8. One-fourth of all prescription drugs in the United States have at least one ingredient that was originally derived from plants. Many vitamins and over-the-counter medications also have ingredients that come from plants. Find two examples of over-the-counter medications, vitamins, or remedies that have ingredients derived from plants.

Type of medicine:	Ingredient:
_____	_____
_____	_____

9. According to a recent survey, only a small percentage of shoppers go to a mall with the intention of buying a specific item. Take a poll of 10 random shoppers to find out what percentage of them are shopping for a specific item. If they didn't come for something specific, why did they come?

Number of people looking for a specific item: _____

Percent: _____

Number of people not looking for a specific item: _____

Percent: _____

Reason they went shopping:

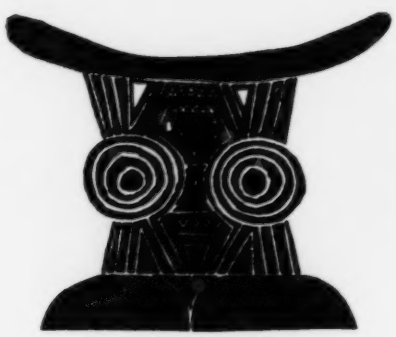
activity 8: techno sapiens*

Overview: Discuss how our separation from nature may contribute to the loss of biodiversity.

What You Need: "Web of Life" video, writing materials, copies of the checklist on page 35, (Optional: camera, video camera, magazines, scissors, glue, and other art supplies)

Objectives: Define "techno sapiens." Discuss people's relationship to the natural world, then come up with a way to portray that relationship.

Related Video Segments: Techno sapiens (II); Why are we losing biodiversity? (I)



Computers, compact discs, cars, and e-mail—today, most of us are more involved with technology than we are with the natural world. Some people, like photographer James Balog in "Web of Life," believe that our increasing reliance on technology separates us more and more from nature. And because we're out of touch with the natural world, we're unaware of—and unconcerned by—the loss of biodiversity. Your students can explore their own thoughts about this trend, first by creating a definition for "techno sapiens," and then by finding a way to illustrate people's relationship to the natural world.

To start the activity, explain to your group that you will show them a segment from "Web of Life." As they watch, they should think about what the message of the segment is. Then show the "Techno sapiens" segment in which photographer James Balog discusses his belief that humans are evolving from homo sapiens into techno sapiens. Afterward, ask students to explain what they think the message of the segment is. (Increasing reliance on technology separates us more from nature, making us more unaware of and unconcerned by the loss of life's diversity.)

Next, have students discuss what they think it means to be a techno sapien. They can build on James Balog's ideas and add their own. Ask if they think of themselves as techno sapiens. Listen to students' answers. Then pass out copies of the techno sapiens checklist on page 35. After students complete the checklist, ask if they changed their opinion on whether they consider themselves to be techno sapiens. Then continue the group discussion by asking the following questions:

- What are the pros and cons of an increasing reliance on technology? (Some of the pros are that technology helps us do things that would otherwise be impossible to do or that would take much longer to do; technology can help increase communication and information sharing; and some technology, for example satellite imagery, can help us understand the environment and what's happening to it. Some of the cons might be that we could be at a loss if the technology we rely on breaks; technology consumes a lot of natural resources to produce, use, and dispose of; technology can lead to fewer interpersonal interactions.)
- What do we lose, if anything, by being less connected to the natural world? (Answers might include loss of inspiration, renewal, and beauty that can come from the natural world; loss of understanding of how the world works and how we depend on it to live.)
- How could this separation from nature be contributing to the loss of biodiversity? (By being out of touch with nature, we're unaware of, and therefore unconcerned by, the loss of biodiversity.)
- What do you think humans will be like 50 years from now? Will humans change physically,

* "Techno sapiens" is a trademark of photographer James Balog.

intellectually, or morally? (Answers will vary. They could relate to health issues, intellectual capacity, ethics, and beliefs.)

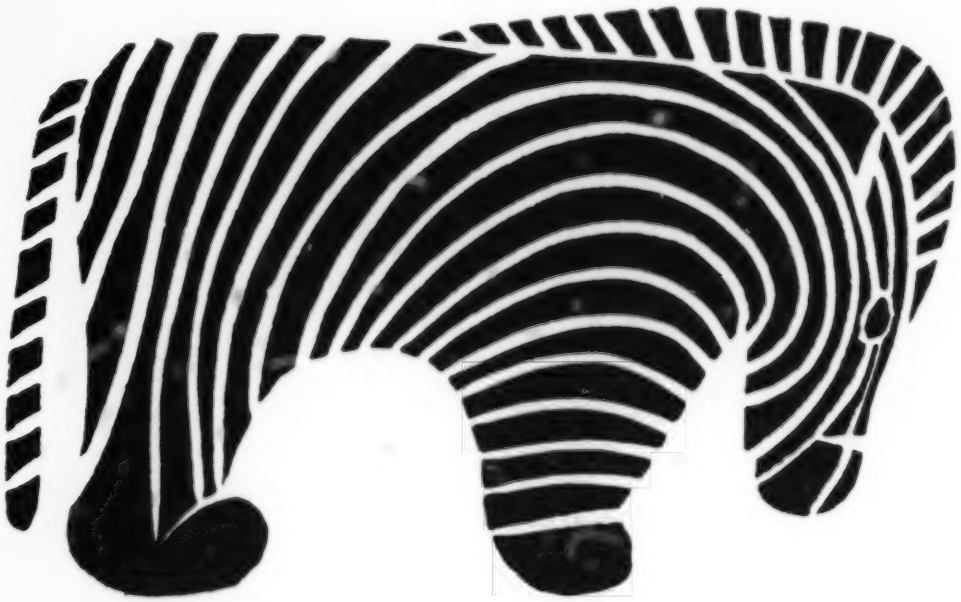
- Are you involved with nature as much as you would like to be? Do you think you should be more involved with nature? Why or why not? If you would like to be more involved, how could you achieve this goal? (Students could plan a camping trip or day-long outing; grow plants or start a garden; visit parks and other natural places more frequently; and so on.)

After the discussion, have students work in small groups to create an imaginative way to portray people's modern lives and the effects of being techno sapiens. The teams can create a video or photo study, write a song or poem, make a drawing, create a sculpture, cut out pictures and photos from magazines to make a montage, and so on. When their presentations are complete, have teams share their ideas with the rest of the group.

Branching Out

- Have students talk with parents, grandparents, and other adults in their community to find out how people's connection with nature may have changed over time. Did the people they talk with feel more connected with nature when they were younger? If so, how?

- Ask students to keep a log of their daily interactions with nature—everything from watching a bird drink from a puddle, noticing new flowers in bloom, or hearing a bird call, to observing the moon and stars. Have the students periodically share some of their interactions and discuss whether being observers of the "daily doings in the natural world" has helped them be more connected to nature. Also ask them to discuss the feelings and insights they had as they observed nature.



techno sapiens checklist

Check the things you did this week.

- [ ] watered a plant
- [ ] heated up food in the microwave
- [ ] watched a bird carefully
- [ ] visited a park or other natural area
- [ ] used a computer
- [ ] made a phone call
- [ ] touched a tree's bark
- [ ] sat in the sun
- [ ] watched TV
- [ ] saw a bird fly
- [ ] listened to a CD or tape
- [ ] admired flowers
- [ ] listened to the radio
- [ ] stopped to notice the wind on your face
- [ ] watched a "wild" animal (not a pet)
- [ ] played a video game
- [ ] surfed the Internet
- [ ] noticed the phase of the moon
- [ ] rode in a car or bus
- [ ] watched or recorded a video

section IV: what are we doing about the loss of biodiversity?

"Never doubt that a small group of thoughtful, committed citizens can change the world. Indeed, it's the only thing that ever has."

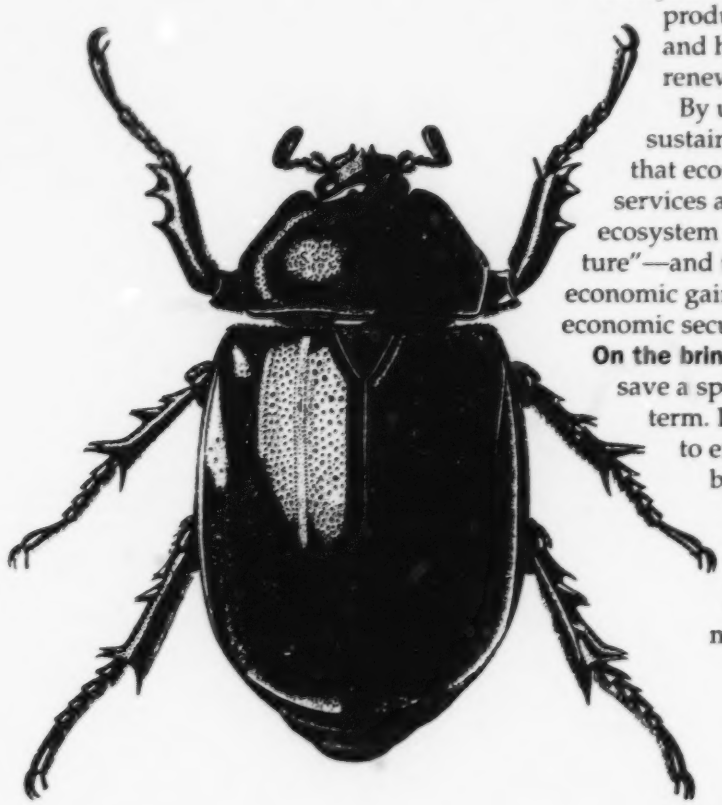
— Margaret Mead, anthropologist

Just as we have no single reason for losing biodiversity, we have no single solution for protecting it. The successful protection of biodiversity will take an integrated effort on several fronts, from supporting scientific research to passing effective laws that protect species and ecosystems. Here are some examples:

Parks, preserves, and priorities: With habitat destruction ranking as the number one reason for diminishing biodiversity, many efforts focus on protecting the places where plants and animals live. Around the world, only about 5 percent of land has been set aside as parks and preserves, leaving an overwhelming amount of land unprotected. The percentage of the sea that is protected is even lower.

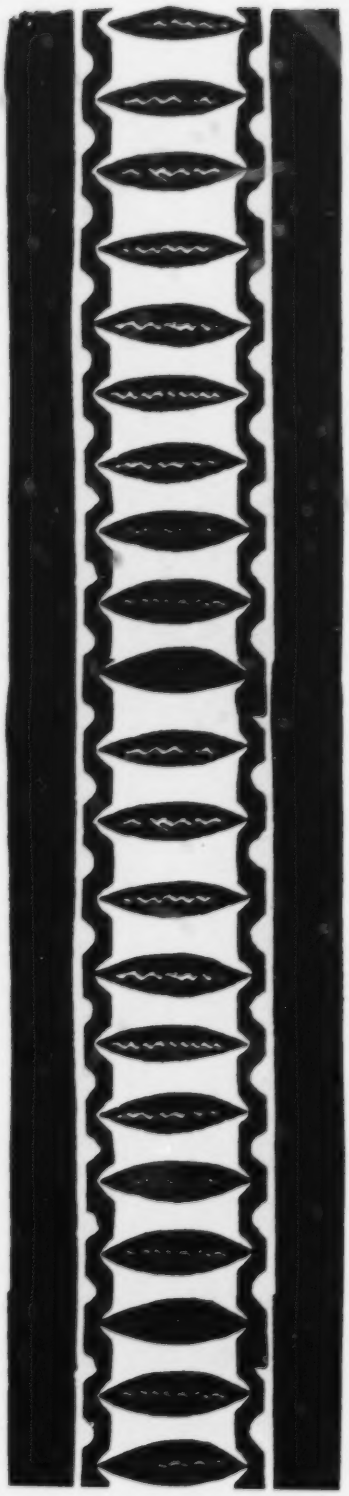
To help protect the most severely endangered ecosystems, some conservation organizations advocate following a priority system. Under this system, for example, it's most important to establish parks immediately in countries like China, the Philippines, and Vietnam, which have few protected areas and high rates of deforestation. Countries such as Malaysia, which have high rates of deforestation but many protected areas, would be a lower priority.

A new approach: Most experts agree that protecting biodiversity needs to go beyond creating new marine and terrestrial parks. It also means taking better care of the areas we do use—from managing forests for species protection, ecosystem services, and timber production to using chemical fertilizers judiciously and harvesting fish populations at a rate they can renew themselves.



By using the world's resources in a way that's sustainable, many experts feel that we can ensure that ecosystems will continue providing essential services and resources to future generations. This ecosystem approach requires looking at the "big picture"—and that sometimes means sacrificing short-term economic gains for long-term resource availability and economic security.

On the brink: Sometimes experts feel that the best way to save a species is to take it out of the wild for the short term. In cases in which a species is dangerously close to extinction, scientists have turned to captive breeding programs. The black-footed ferret, California condor, golden-lion tamarin, and whooping crane are just a few species for which individuals have been taken out of the wild and bred in a controlled environment. If the population of an endangered



species builds up in captivity and if there is suitable habitat, biologists can release individuals into the wild.

Saving seeds: To help preserve the world's diversity of food plants, people are storing seeds and other plant parts in gene banks. Each plant cell contains a complete copy of a plant's genetic information. Even if a plant species disappears in the wild, scientists hope to be able to grow it from its seeds—or even clone the plant from its other parts. (For more about plant gene banks, see pages 42-43 of *WOW!*)

Rapid research: One of the tragedies of declining diversity lies in the probability that we're wiping out species before we even know they exist. Scientists are working to identify unnamed species and to learn all they can about the Earth's known species and ecosystems. It's a daunting challenge—of the 1.4 million species scientists have identified, little more than 10 percent of them have been studied in any detail. But identifying species isn't enough: Scientists and resource managers need to learn how to conserve the diversity of genes, species, and ecosystems on land, in freshwaters, and in the sea.

Increasing awareness: The race to save biodiversity has taken the spotlight lately in magazines, in newspapers, and on television. This increased attention means that more of us are learning about the importance of preserving biodiversity. People are beginning to find out about what's being done to protect biodiversity. And they are also discovering how complex biodiversity issues are. For example, while captive breeding programs are a hopeful solution to imperiled populations, they are very expensive and their success is far from guaranteed. And gene banks are not a solution for seeds that spoil over time. But as people become aware of the problems as well as efforts to protect biodiversity, we will be better equipped to make decisions that affect biodiversity. (For a summary of the projects featured in "Web of Life," see pages 3-7 of this guide. Also see page 61-65 of *WOW!* for some ways students are working to protect biodiversity in their own communities.)

On the legal side: An increase in public awareness has put pressure on local and national governments to pass laws that protect biodiversity. The Endangered Species Act, international trade laws such as the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the Montreal Protocol, and other crucial laws and treaties have already helped to protect some species and habitats. But some experts feel we must do much more to preserve all species and to help keep ecosystems intact. On local, national, and international levels, concerned citizens and politicians are working to develop policies and pass laws that foster sustainability, give communities and individuals incentives for effective conservation, and call for international cooperation.

It's up to us: People are the reason for diminishing biodiversity—but it's clear we are also the solution. Maintaining biodiversity doesn't mean we have to be scientists. Each one of us can do something to help preserve our planet's variety of life. We can use fewer resources by

turning down the heat, driving less, recycling materials, and refusing to buy products that we use only once. We can establish greenways in urban areas and create habitat for wild species in our back yards and school yards to help reconnect increasingly fragmented pockets of nature. And we can use the land more sustainably by limiting our use of pesticides and chemical fertilizers.

Perhaps the most important thing we can do is to realize that we too depend on other species for our survival. That realization is the first and simplest step for us to take if we are to maintain our planet's array of life—and all the essential services that go along with it.

BEST COPY AVAILABLE

activity 9: the biodiversity campaign

Overview: Review biodiversity ads and create your own to educate others about biodiversity.

What You Need: copies of Green Team Ads on pages 40-41, paper, poster-sized paper, pencils, markers, and other drawing materials

Objectives: Critique a variety of public service announcements about biodiversity. Design and create ads to educate others about biodiversity.

Educating the public about a complex and sometimes misunderstood subject like biodiversity can be a real challenge. But Green Team, an advertising firm in New York, is tackling it head on—and you can too! By presenting biodiversity in a way that people can relate to, Green Team is trying to make people aware of the value of biodiversity.

To start this activity, provide your students with copies of the Green Team Ads on pages 40-41. (They can look at the ads individually or in groups.) Then write on the board the questions listed below.

- Do the ads grab your attention? Why or why not?
- What is the key message of each ad? Is it clear?
- Is the message something most people can relate to and understand?
- Are the ads successful at helping people understand and value biodiversity? Why or why not?

Before leading a class discussion, either ask your students to write their responses to the questions, or have students discuss the questions in small groups.

Challenge your students to each design a full-page biodiversity ad for a magazine or for a poster. Their ads can focus on an aspect of species diversity, ecosystem diversity, or genetic diversity. Like the Green Team Ads, the students' ads can focus on foods and medicines that benefit people. But their ads can also relate to other biodiversity issues, such as recreational benefits.

Tell your students that before designing their advertisements, they should decide who their audience is. For example, they could "target" a particular age range (peers, parents, young kids, senior citizens). They should decide what their message is and whether they need examples to illustrate their message. By doing these things first, students will find it easier to come up with an interesting design. Also have your students brainstorm a list of characteristics that make ads effective. The list could include the following points:

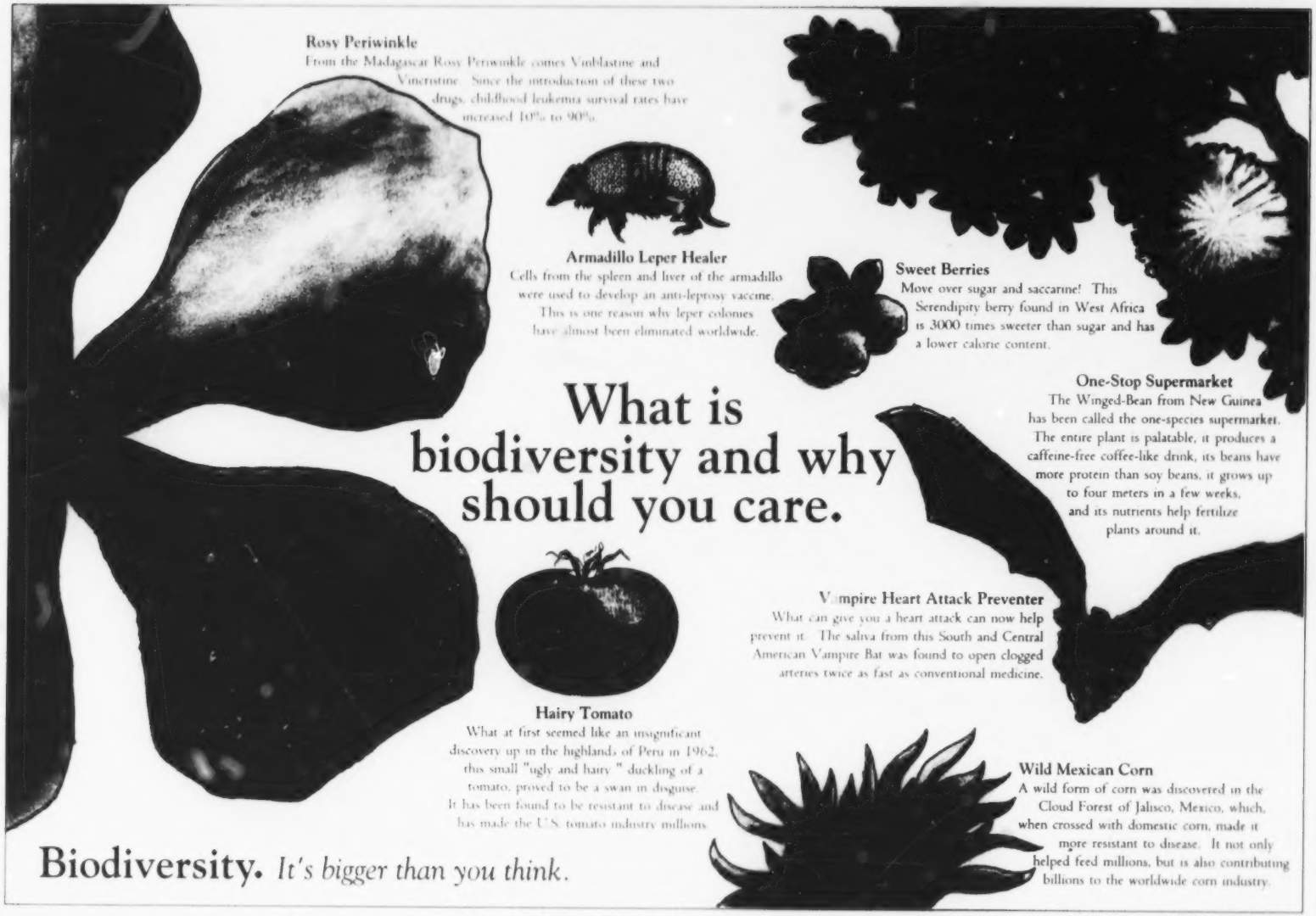
- Present a clear message.
- Relate the message to people's lives.
- Make the ad attractive and interesting enough to grab people's attention.

Have students draft their ads before working in final form. Then provide plenty of colorful markers and drawing tools for their final ads. Hang their finished works in a library, mall, town hall, or other place where the public can see them.

Branching Out

- Hold a contest in which students vote for the most effective ads. Categories could include best message, most creative, best example, and so on. Award prizes for each category.
- Send a few of the best ads to Green Team in New York. The address is Green Team Advertising Inc., 33 Howard Street, New York, NY 10013-3111.

Activity adapted from *Windows on the Wild*—an environmental education program published by World Wildlife Fund, copyright 1995.


Rosy Periwinkle
From the Madagascar Rosy Periwinkle comes Vinblastine and Vincristine. Since the introduction of these two drugs, childhood leukemia survival rates have increased 10% to 90%.
Armadillo Leper Healer
Cells from the spleen and liver of the armadillo were used to develop an anti-leprosy vaccine. This is one reason why leper colonies have almost been eliminated worldwide.
Sweet Berries
Move over sugar and saccarine! This Serendipity berry found in West Africa is 3000 times sweeter than sugar and has a lower calorie content.
What is biodiversity and why should you care.
One-Stop Supermarket
The Winged-Bean from New Guinea has been called the one-species supermarket. The entire plant is palatable, it produces a caffeine-free coffee-like drink, its beans have more protein than soy beans, it grows up to four meters in a few weeks, and its nutrients help fertilize plants around it.
Vampire Heart Attack Preventer
What can give you a heart attack can now help prevent it. The saliva from this South and Central American Vampire Bat was found to open clogged arteries twice as fast as conventional medicine.
Hairy Tomato
What at first seemed like an insignificant discovery up in the highlands of Peru in 1962, this small "ugly and hairy" duckling of a tomato, proved to be a swan in disguise. It has been found to be resistant to disease and has made the U.S. tomato industry millions.
Wild Mexican Corn
A wild form of corn was discovered in the Cloud Forest of Jalisco, Mexico, which, when crossed with domestic corn, made it more resistant to disease. It not only helped feed millions, but is also contributing billions to the worldwide corn industry.
Biodiversity. It's bigger than you think.

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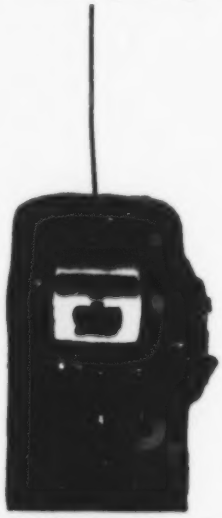
How this tree
in Brazil
produces a fuel
that is cleaner and cheaper
than what comes out
of this pump.

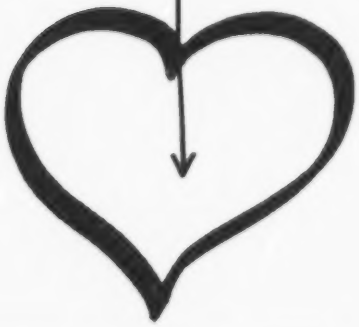


The Copaiba Tree found in Brazil has a fuel-like liquid that can be pumped directly into a diesel truck.

Biodiversity.
It's bigger than you think.

© 1995 Green Team Advertising, NY

How this
heart-stopping vampire bat
can help prevent
heart attacks.



Instead of giving you a heart attack, vampires may well help prevent it. The saliva from this South and Central American vampire bat was found to open clogged arteries twice as fast as conventional medicine. These compounds are now being developed to help prevent heart attacks.

Biodiversity.
It's all here for a reason.

activity 10: biodiversity bios

Overview: Find out about people who work to conserve biodiversity.

What You Need: "Web of Life" video, writing materials

Objectives: Investigate careers related to biodiversity and discuss them. Write a description of a "perfect biodiversity job for me."

Related Video Segments:

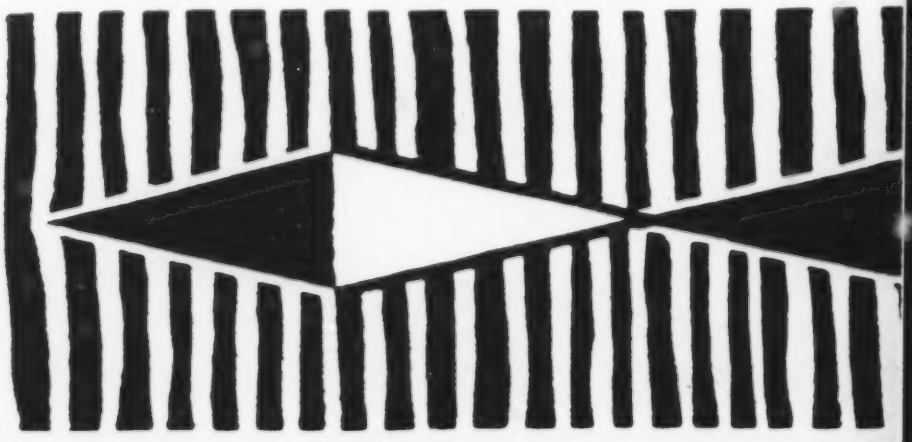
- **Career as Researcher: Tropical adventure (I); Capturing kangaroo rats (I); Fungi—finding the connections (I); Songbirds in the night (I); Wildflowers, diversity, and drought (II); Biological reconnaissance (II)**
- **Career as Naturalist: Tropical adventure (I)**
- **Career as Artist: Tracking the sounds of diversity (I); Ancient music, threatened cultures (II); Techno sapiens (II)**
- **Career as Community Organizer: Wildlands (II); Local solutions (II)**

"Web of Life" highlights various people who are working to protect biodiversity and make people aware of the problems and solutions. Whether committing their careers to biodiversity issues or getting involved through a hobby, the people featured in "Web of Life" demonstrate some of the many ways people can make a difference. This activity introduces your students to researchers, naturalists, park officials, and community organizers dedicated to protecting biodiversity and will get them to think about career possibilities.

First, select a mix of video segments that demonstrates the various ways people are involved in protecting biodiversity. (See related video segments.) Before showing the segments, explain to your students that you would like them to think about the projects and careers highlighted in the video. Which would they like to be part of? Which would they enjoy?

After showing the video segments, ask students to jot down on a piece of paper which project or job interests them most and the reasons it intrigues them. Then have students share their ideas in small groups of four or five. Afterward, tally students' responses about which projects and careers were of most interest. Discuss the tally with the class. Did most students have similar interests, or were their choices varied? What were the reasons behind the students' interests in particular careers or projects? Then use the following questions to lead a class discussion to help students think more specifically about their career interests:

- Would you enjoy a career in which you could be outdoors at least part of the time—perhaps as a researcher or naturalist? Or would you prefer a career in which you could work indoors most of the time? (Even field researchers need to spend chunks of time indoors analyzing the results of their research, sharing their information with others, and sometimes writing grants to be able to do more research.)
- Would you be more interested in working on biodiversity

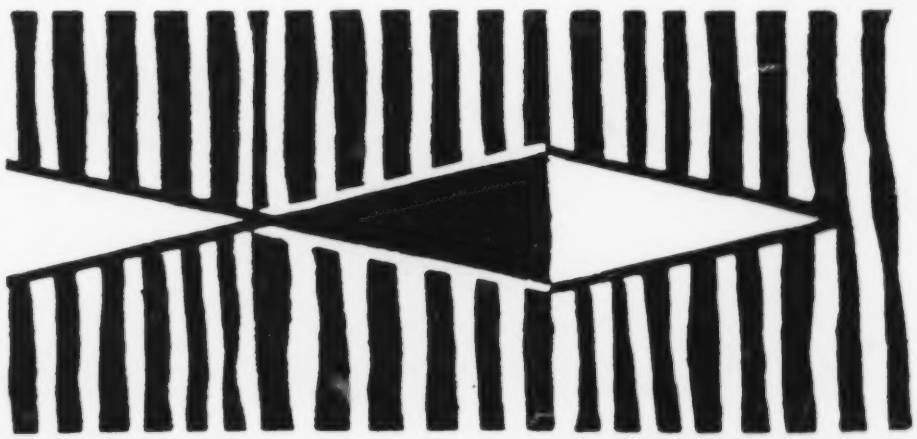


issues in your own area, or would you prefer to work in more distant places? Are you interested in international work? If so, what interests you about it? What are the pros and cons of working far from home?
- Would you prefer to have a career in which you interact a lot with other people (for example, leading trips for tourists or organizing local people to solve a local problem), or a career in which you work independently or in small groups?
- Which is more interesting to you: working to make new discoveries as researchers do or helping others understand what we are learning about biodiversity as naturalists and educators do?
- What kinds of skills and background do you think the people in the video needed to do their jobs? What do you think they needed to learn in order to accomplish what they did?
- What other careers and jobs related to protecting biodiversity are not covered in "Web of Life?" (Many careers, such as public policy, environmental law, city planning, resource management, environmental engineering, and green business, relate to protecting biodiversity.)

Ask your students to use the discussion to write a description of the "perfect biodiversity job for me." Explain that they not only can use specific examples from the video segments, but also can select careers, research topics, and geographical regions not covered in the video. Their descriptions should explain the job in as much detail as possible and the reasons why it suits them. Afterward, have the students share their "biodiversity bios" in small groups.

Branching Out

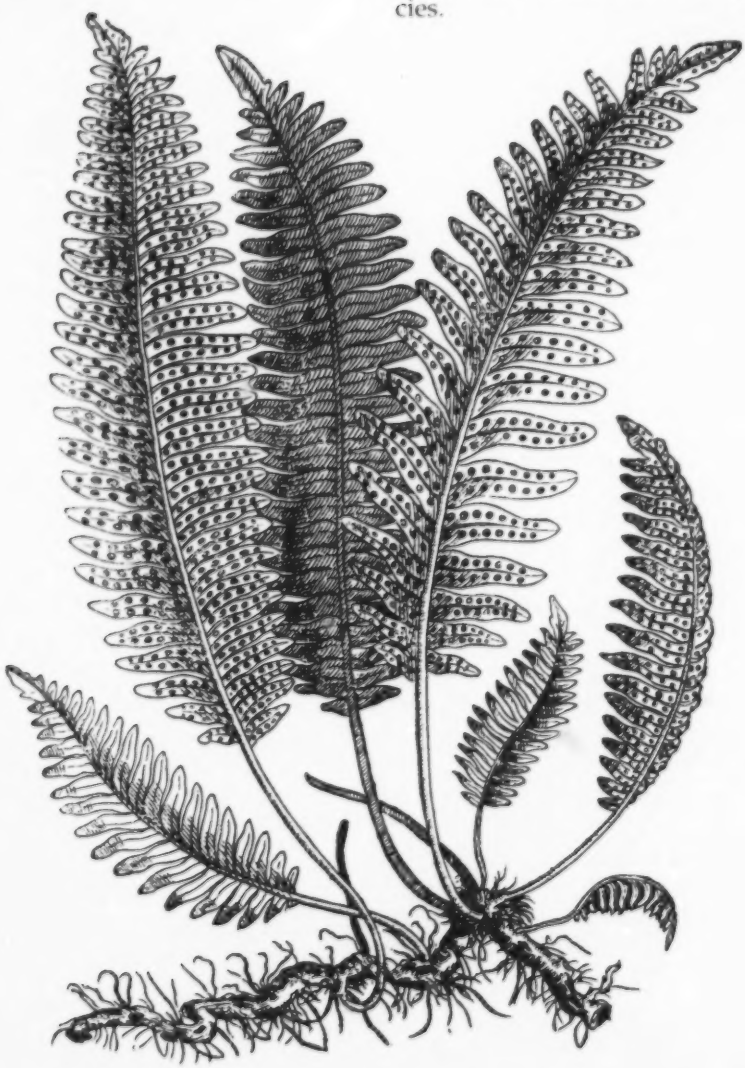
- If possible, invite a naturalist, ecologist, or other person familiar with biodiversity issues to your class. Ask the person to talk about his or her job—likes and dislikes, the background necessary to do it, and so forth.



"Web of Life" glossary

adaptation: a behavior, physical feature, or other characteristic that helps an animal or plant to survive in its habitat. For example, kangaroo rats have long legs that help them hop quickly away from predators.

biodiversity: the diversity of life on Earth, reflected in the variety of ecosystems and species, in their processes and interactions, and in the genetic variation within species.



biological assessment: the process by which scientists identify the species in a particular ecosystem. In "Web of Life," for example, scientists performed a biological assessment in the Kikori wilderness of New Guinea.

canopy: the layer of a forest formed by the crowns of tall trees. In a tropical rain forest, for instance, the canopy is made up of flat-crowned trees that are often about 65-100 feet tall.

community: a group of interacting plants and animals living in the same area at the same time.

conservation biology: a multidisciplinary science that deals with conserving biodiversity. Its goals are to investigate human impacts on biodiversity and to develop approaches to prevent extinction through stewardship of entire biological communities.

ecosystem: a community of plants, animals, and microorganisms that are linked by energy and nutrient flows, and that interact with each other and with the physical environment. Rain forests, deserts, coral reefs, and grasslands are examples of ecosystems.

endemic: an animal or plant species that naturally occurs in only one area or region. For example, desert poppies are endemic to Las Vegas, Nevada.

evolution: the process by which a species' characteristics change over time in response to changes in environmental conditions. "New" species develop in this way. For example, scientists believe that whales gradually evolved from land animals.

extinct: a species that is no longer living. The passenger pigeon and moa are examples of extinct birds.

extinction spasm: a great number of extinctions occurring in a relatively short period of time. The last great extinction spasm took place 65 million years ago when the dinosaurs became extinct. An extinction spasm is also called a mass extinction.

fungi: a kingdom of nonphotosynthetic organisms that absorb their nutrients from dead or living organisms. Yeasts and molds are types of fungi.

gene bank: a facility that stores genetic material. For example, the U.S. Department of Agriculture's gene banks store seeds and other plant parts.

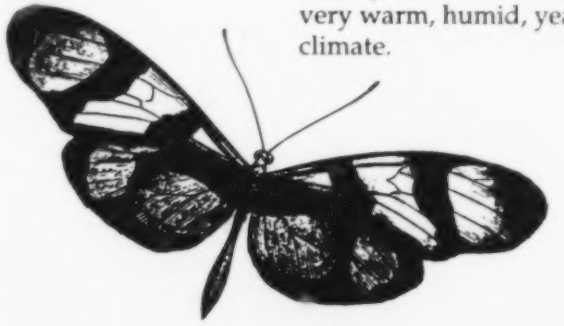
genes: the coded information in organisms' cells that makes species and individuals unique and that is transmitted from one generation to the next. Genes determine how organisms look and how they behave. For example, genes are responsible for hair color and texture in humans, and for resistance to disease in corn.

genetic diversity: the genetic variation present in a population or species. For example, the hundreds of different varieties of tomatoes exhibit differences in size, shape, color, taste, and rate of growth.

habitat: the area where an animal, plant, or microorganism lives and finds the nutrients, water, sunlight, shelter, living space, and other essentials it needs to survive. Habitat loss, which includes the destruction, degradation, and fragmentation of habitats, is the primary cause of biodiversity loss.

introduced species: an organism that has been brought into an area where it doesn't naturally occur. Introduced species often compete with and cause problems for native species. Introduced species are also called exotic, non-native, and alien species.

keystone species: a species, such as the gopher tortoise, that affects the survival and abundance of many other species in the community in which it lives. If a keystone species is removed, there may be a significant change in the composition of the community and even in the physical structure of the environment.



native species: a species that occurs naturally in an area.

nonrenewable resource: a resource that is in limited supply and can't be replenished by natural processes within human life spans. Fossil fuels are nonrenewable resources.

ornithology: the study of birds.

over-consumption: the use of resources at a rate that exceeds the ability of natural processes to replace them.

renewable resource: a resource that, if soundly managed, can be replenished through natural processes within human life spans. Trees and solar energy are examples of renewable resources.

sustainable: supportable over the long term. A sustainable way of life is one in which human needs are met without diminishing the ability of people, other species, or future generations to survive.

tropical rain forest: a broadleaf, evergreen forest located at low elevations in regions between the Tropics of Cancer and Capricorn. Tropical rain forests are characterized by abundant rainfall and a very warm, humid, year-round climate.

to find out more

"Web of Life" World Wide Web Page

WQED Pittsburgh has built a World Wide Web site highlighting sections of the "Web of Life" video. It includes a description of the video, a preview you can download, music samples, bird calls from Cornell University's Laboratory of Ornithology, photographs by James Balog, and nature sounds from Gordon Hempton, the "Sound Tracker." It also provides information about World Wildlife Fund. This World Wide Web page is hosted by Envirolink Network. The address is http://www.envirolink.org/orgs/wqed.

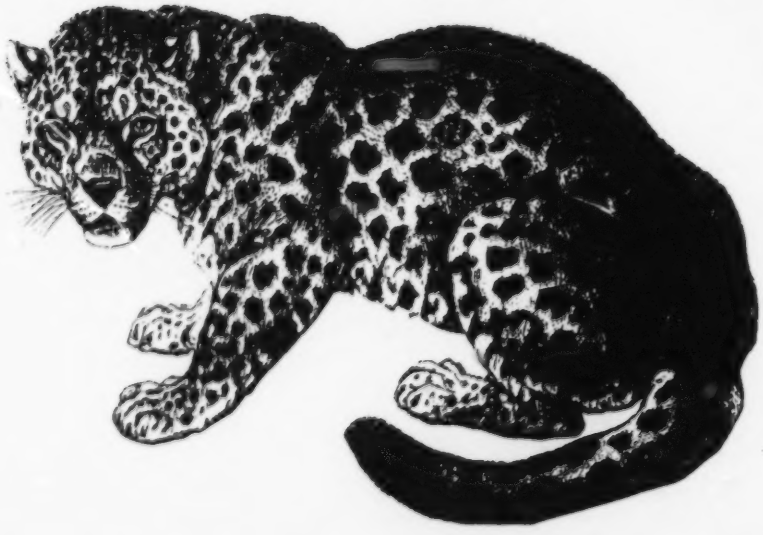
General Background for Educators

Conserving the World's Biodiversity by Jeffrey McNeely, Kenton Miller, et al. Explains what biodiversity is, why it's important, and how to conserve it. Order through Island Press, P.O. Box 7, Covelo, CA 95428. (Conservation International, IUCN, World Bank, World Resources Institute, and World Wildlife Fund, 1990)

Saving Nature's Legacy: Protecting and Restoring Biodiversity by Reed F. Noss and Allen Y. Cooperrider. Written by two leading conservation biologists, this book is a thorough and readable introduction to issues of land management and conservation biology. (Island Press, 1994)

The Diversity of Life by Edward O. Wilson. An excellent introduction to biodiversity that looks at how the species of the world became diverse, what the causes and consequences of biodiversity loss are, and what people can do to help tackle the crisis. Engaging writing style and personal accounts. (W.W. Norton, 1992)

The Biophilia Hypothesis edited by Stephen R. Kellert and Edward O. Wilson. Biophilia is our natural affinity for life. Through his vivid descriptions of life on Earth, Wilson seeks to awaken this human trait in readers. (Harvard University Press, 1994)



Survivors—A New Vision of Endangered Wildlife by James Balog. A collection of photographs of endangered or protected animals in surreal and unnatural environments. The images symbolize endangered animals' struggle for survival. (Harry N. Abrams, Inc., 1990) Other books by James Balog include *Wildlife Requiem* and *Anima*.

Other Activity Sources

Green Inheritance Teaching Pack (grades 4-8) produced by WWF-UK. Covers a range of plant conservation issues. Also includes teacher background materials, student sheets, resource lists, and a wall chart. Write to WWF-UK, Publishing Unit, Panda House, Weyside Park, Godalming, Surrey, GU7 1XR England.

NatureScope (grades K-8) is an education series published by the National Wildlife Federation. The issues *Endangered Species: Wild and Rare* and *Pollution: Problems and Solutions* are especially relevant to biodiversity. Includes background information, activities, and student pages. Contact National Wildlife Federation, 1400 16th Street, NW, Washington, DC 20036-2805.

Our Only Earth: A Curriculum for Global Problem Solving (grades 4-12) by Linda MacRae-Campbell, Micki McKisson, and Bruce Campbell. Includes teacher and student background materials and activities focusing on seven global problems including tropical rain forests, poverty and population, and endangered species. Contact Zephyr Press, P.O. Box 66006, Tucson, AZ 85728.

Project WILD (grades K-12) sponsored by the Western Regional Environmental Education Council, Inc. Project WILD is a national education program that sponsors workshops in every state and provides participants with a comprehensive curriculum guide filled with wildlife-related activities. Also available—*WILD School Sites: A Guide to Preparing Habitat Improvement Projects on School Grounds.* Includes project ideas and a plan to help you organize your project. Write to Project WILD, 5430 Grosvenor Lane, Bethesda, MD 20814.

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Seeds of Survival Teaching Kit (grades 10-12) produced by Unitarian Service Committee Canada. Examines the importance of seed preservation and the challenge of ensuring the survival of food-producing seeds. Designed for senior high students, it could be used with advanced middle school classes. Includes a synchronized slide-audio presentation, reproducible student materials, and large seed map. Available from USC Canada, 56 Sparks, Ottawa, Ont. K1P 5B1, Canada.

Threatened and Endangered Animals (grades 6-12) by David Hagengruber and Harold Hungerford. Provides background information, issue investigations, and plans for citizenship action on specific wildlife case studies. Contact Stipes Publishing Company, 10-12 Chester Street, Champaign, IL 61820.

Backyard Biodiversity and Beyond (grades 5-8) by Deanna Binder, Stewart Guy, and Briony Penn. A resource kit that brings messages about the nature and value of biodiversity in British Columbia into the backyards of your homes and your school. Five modules present activities in a variety of subject areas. Available from Ministry of Environment, Lands and Parks, 810 Blanshard Street, Victoria, B.C. V8V 1X4, Canada.

Video

The Diversity of Life (grades 9-12) examines the incredible variety of plant and animal species. It describes the importance of preserving endangered species and habitat, and it explores possible solutions to the loss of biodiversity. Available from National Geographic Society, Educational Services, 1145 17th Street, NW, Washington, DC 20036.

How to Make a Difference (grades 7-12) is a series of three videos on endangered species, wetlands, and population. Each video provides background information and examples of people working for change in their communities. Available from Make a Difference Videos, National Audubon Society Productions, P.O. Box 364, Matawan, NJ 07747.

Spaceship Earth (grades 4-12) is an Emmy Award-winning video exploring the global links among nature, people, and technology. It explores many critical environmental issues, including rain forest destruction. Narrated by young people. Contact Acorn Naturalists. Available from Acorn Naturalists, 17300 East 17th Street, Suite J236, Tustin, CA 92680.

Variety and Survival (grades 7-12) explores why variation is important for the survival of communities and species. Then it examines overpopulation and species extinction. Available from Journal Films, 1560 Sherman Avenue, Suite 100, Evanston, IL 60201.

The Last Show on Earth (grades 7-adult) celebrates the efforts of individuals who are struggling to save endangered species while poignantly illustrating the root causes of extinction: loss of habitat, overpopulation, exploitation, and greed. Available from Bullfrog Films, P.O. Box 149, Oley, PA 19547.

Green Means (ages 12-adult) is a series of 32 short programs about ordinary people who are making positive contributions to the health of the planet. Available from Environmental Media, P.O. Box 1016, Chapel Hill, NC 27514.

The Video Project—Films and Videos for a Safe and Sustainable World has an eco-video collection for schools. Many of the films relate to biodiversity topics. Catalogues are available from the Video Project, 5332 College Avenue, Suite 1E, Oakland, CA 94618.

Videodisc

Animal Pathfinders (grades 5-12) is an interactive program that simulates a field trip to study animals in their natural habitats. Available through Scholastic Software, Scholastic Inc., 2931 East McCarty Street, P.O. Box 7502, Jefferson City, MO 65102.

GTV: Planetary Manager (grades 5-12) encourages students to investigate environmental problems and grapple with solutions. Available from National Geographic Society, Educational Services, 1145 17th Street, NW, Washington, DC 20036. Also available fromVideodiscovery, 1700 Westlake Avenue North, Suite 600, Seattle, WA 98109, which has a variety of other science-related videodiscs.

Habitat and Dependence (grades 6-12) looks at habitats, food chains, and interdependence, as it examines how humans affect habitats. Available from Journal Films, 1560 Sherman Avenue, Suite 100, Evanston, IL 60201.

Simulation: Saving an Endangered Species comes on Disk V: Land (grades 9-12). An interactive tutorial on land use, wilderness, and endangered species. Available from Queue, Inc., 338 Commerce Drive, Fairfield, CT 06430.

STV: Rain Forest (grades 5-12) gives students a close-up look at rain forests and why they're in trouble. Available from National Geographic Society, Educational Services, 1145 17th Street, NW, Washington, DC 20036.

CD-ROM

Earth Explorer, the Multimedia Encyclopedia of the Environment (ages 11-adult) presents information on critical environmental issues. It includes games to develop thinking skills, a compendium of original graphic art, media presentations and audio clips, interactive data sets, and several hundred articles and photos in interactive formats. Sponsored by the National Science Foundation and prepared in cooperation with the American Association for the Advancement of Science.

Acknowledgments

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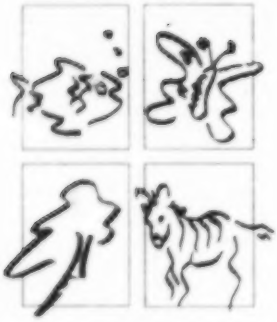

WINDOWS ON THE WILD

This education kit was produced by World Wildlife Fund and WQED Pittsburgh with support from Eastman Kodak Company. It is part of WWF's *Windows on the Wild*™ environmental education program.

The "Web of Life: Exploring Biodiversity" video was produced by WQED Pittsburgh in association with WWF with funding provided by The John D. and Catherjne T. MacArthur Foundation.

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